UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

***

WORKSHOP FOR ENTOMBMENT OPTION FOR POWER REACTORS

U.S. NRC

Two White Flint North, Auditorium

11545 Rockville Pike

Rockville, MD

Tuesday, December 14, 1999

The above-entitled workshop commenced, pursuant to notice, at 10:00 a.m.

P R O C E E D I N G S

[10:00 a.m.]

TROTTIER: Good Morning.

My name is Cheryl Trottier and I am from the Office of Research and I want to welcome you to the workshop that we are holding for today and tomorrow on entombment. Before we get started, I'll tell you what we are trying to do here is we are transcribing this meeting. So we are going to give plenty of opportunity for the public to comment on the issues that we are discussing, and my main concern is that you attempt to get to the mic because otherwise we won't be able to obtain your comments are critical to our review. So it's important that you remember to go the microphones. We have two microphones in each isle and hopefully that will enable us to get a good recording.

What we are going try and do is have a mix of people presenting papers and a discussion of the issues that we raised on our Federal Register Notice. Hopefully everyone has gotten a pack of the handouts and if not, there are out on the front table, but within that pack should be a copy of the Federal Register Notice with the issues. But we will go over them some more later on. But we are going to present some information that we think is pertinent to the issue and then we will also have plenty of opportunity for comment and the primary reason why we scheduled it for two days was so that we would have a lot of opportunity for that comment; and we are going to set it up so that the first panel will begin this afternoon. But if we get to the point at the end of the day where we are running out of time we'll

delay continuing that panel until tomorrow afternoon so just so you know that's our format is the attempt is to try and get through all of the issues for the first panel this afternoon, but rather than go very late today we felt it would be better to just get as far as we can. End at a reasonable time and then we'll continue that panel on Wednesday afternoon if we need to.

And with that, I think I'd like to turn this over to Tom King first who is going to give some opening remarks, and then to John Greeves from our office of Nuclear Material Safety and Safeguards. Thank you.

KING: Thanks, Cheryl. As Cheryl said, my name is Tom King. I am with the office of research, director of the division Risk Analysis and Applications in which Cheryl's branch is now located in that division and to work on entombment to developing the SECY paper which you received copies of and some of the technical work on the viability of entombment was done in the office of research. The main thing I wanted to mention, just in my opening remarks is why are we having this workshop and how will the results be used. Basically, the purpose of the workshop is to discuss the viability of the interest in concerns with and other issues associated with use of entombment option as a generic decommissioning alternative of power reactor license termination. Right now what we generically permit are basically prompt or deferred dismantlement.

Entombment, if it is pursued or would be pursued at all, today would have to be done on a case-by-case basis and that would require commission review and approval. This

workshop is one in a series of steps taken by the staff to respond to direction from the commission we received back in April 1997 where they asked us to consider the technical viability of entombment and to what extent the current rules permit this option. The staff developed a couple of papers on entombment, the most recent one being the SECY 99187 the one that you received when you signed in this morning and basically that paper provided to the commission the results of some analysis done by PNNL looking at basically technical viability of entombment and you will hear more this morning about summary discussion on that analysis.

Of course, there are other issues involved with entombment besides the technical ones, policy issues, economic issues, analysis issues and so forth and they will be discussed at the workshop. Our main desire today is to solicit stake holder views on entombment before any recommendation is made to the commission regarding where we should proceed on this issue.

As Cheryl mentioned, the number of issues that are listed in the Federal Register Notice that went out we did try to invite a broad range of stake holders so that we could get a broad range of views at this workshop. If there are other issues besides the ones that are listed in the Federal Register Notice please bring them up.

You may not have thought of everything for example one issue could be what analysis tools and data do we have today to analyze the entombment option. Particularly for compliance with the license termination rule. Are they adequate and what else needs to be done. The results of the

workshop will be used by the NRC staff to formulate a recommendation to the commission on how to proceed with the entombment option and whether or not that should include rule making.

And right now we are currently scheduled to get back to the commission in June of 2000 with a recommendation and the results of this workshop would certainly play a big role in putting together that recommendation. With that I'll turn it over to John Greeves who also has a view opening remarks.

GREEVES: Good morning. I don't want to take a lot of time, I just wanted to extend my personal welcome as the program office that does a lot of the licensing for these types of activities and I just want to convey your view is very important we want to hear from you what your view on this particular topic is and we need some input from the states. I see a couple of representatives from the states here today and it is very important that you let us know what your views are on this topic.

We need to hear from the public citizens group we've got one signed up to participate. Disposal operators this issue has a contextual issue associated with it. So we need some feed back, I think we are all familiar with the kinds of things that are going on at Barnwell and Envirocare. There is a dynamic going on out there and we need to understand how this fits into that context.

Utilities we are engaged in various ways with the utilities and license termination. Maine Yankee is due to send their plan in shortly, we have a Trojan license

termination plan under review at the present time and Saxton is close to submitting theirs.

Also, DOE is a key player in this process. There is some Greater-than-Class C waste tied up in this issue and they are a key player in the resolution of that process. We are fortunate to have some international representation Paul Woollam has agreed join us and give a presentation on the prospective from the United Kingdom. Those of us in the room I see a lot of familiar faces who have been working the low level radio active waste amendment act for years and I think all of us can see it's not working well. There is a real uncertainty about disposal capacity out there. So this workshop and the paper is about the question of entombment, is it an option, and we particularly want your views. Anybody who has looked at this topic recognizes one of the keys is how much can you leave behind at a particular site. What's the timeframe of interest?

Talking about entombment, you're talking about quite a bit of material and time frames 100 years and beyond. These trigger some discussions that you find in the commission paper.

Also raises questions about institutional control assumptions, what should be the assumptions about leaving material on site terms of institutional controls. The paper raises the Greater-than-Class C waste issue, that waste was indicated to go to the Department of Energy and there's questions raised in this paper what cut it out do you leave it in and what is your prospective on that.

Also raises a whole set of questions about

intruder barriers. Are they effective or are they not effective? We want your views on those topics. It also begs for performance assessment in terms of dose analysis for these types of facilities which is another important topic.

These are things that I think are fair game in this couple of days of meetings and would like to challenge you to participate. Step up to the microphone and let us know what you are thinking on that as it has been mentioned we are keeping a transcript and I find these transcripts valuable. I go back and read them, in terms of the context, how do we proceed with licensing in the future of future role making. So it is very important to get your views on records and I thank all of you in advance and wish you all a successful workshop. Thank you for coming.

TROTTIER: Thank you John and thank you Tom. What I will propose then is that we begin by having our first speaker who today is Carl Feldman and he is going to basically cover some of the issues that we were raised in the SECY that we sent up to the Commission in June.

FELDMAN: Nice to welcome you here to the workshop. I have been doing decommissioning for a long time so I'll just sort of give a history of the entombment status in the past and the present and what it might be like in the future.

Can I have the first slide? Next one. OK. Before 1988 there were very few things before 1988 that were looking at decommissioning for reactors we had regulatory guide 1.86. That wasn't a rule but it gave some guidance

and it was applicable to power reactors. It talked about procedures for terminating the license and what kinds of acceptable radioactivity levels one had to leave the facility in so you could have an unrestricted use license termination.

During that time, probably starting back in 1976 under the old atomic energy sanction there was some thought about doing some rules because the industry was maturing. It was just a matter of time and we were going to have a lot of these reactors that want to terminate their license. And it would be nice to do them all in the same types of standards. And we had a whole bunch of things workshops, public meetings.

But the important thing is that most of rules support of information base was developed between 1976 and 1981 and during that time we didn't foresee the problem with waste disposal. We knew there were problems, we thought they would all be worked out and didn't think it was going to be a big deal.

PNNL developed a whole series of these reports, technology safety and costs, decommissioning everything, we did reactors, we did anything that the NRC license with the exception of low level and high level waste burial and uranium mill tailings.

The NUREGs evaluated the impacts for the various decommissioning alternatives and I'll define those in a minute. We went to these fancy, I call them pseudo-acronym types of alternatives, because of the fact that there were so many different definitions that people were using for

what decommissioning meant and based on these NUREGs we did a generic environmental impact statement that was published in 1986.

Definitions of the alternatives, were that all the alternatives were complete only when the license was terminated for unrestricted release, there was no other type of release. DECON been prompt dismantlement. SAFSTOR for whatever number of years was a delay dismantlement and preceded by a safe storage period. An ENTOMB was a hardening casement of radioactive contaminants disposed of on site and you had to do maintenance and surveillance and it was continued up to the time where the radioactivity and solely through radioactive decay resulted in a dose that was acceptable for unrestricted release. Next slide please.

In the GIS at that time, the conclusions where that the preferred alternatives were DECON and SAFSTOR and pretty much as you might imagine the radioactive dose to the public the thing lied as negligible but you have occupational dose to people that have to dismantlement and if you look at just cobalt-60, there are two principal dominant nuquids and reactors cobalt-60 and cesium-137.

Just looking at the Cobalt-60 get an optimum kind of situation and we found that the reduction in occupational dose, the major one occurred in about 30 years. And it still got reduction dose and it was kind of real slow going down. And then after about 50 years the waste volume had its major significant reduction and then again very slowly and roughly it turned out that the occupational dose dropped by about a third and the waste volume dropped by about a

factor of ten in the 50 years. And DECON, those times we did it for PWR, PWR took the order of 5-7 years something like that.

And so when we did our rule, you see this mentioned later than 60 years we took these two numbers and kind of put them together because everything is supposed to be done ALARA or for health and safety aspects where you have some advantage. And we made the decision that we are going to, say, in 60 years time -- is where you are going to get the major advantages in delay and at the end of the 60 years the license has to be completed -- I'm sorry, terminated at that time, not just at dismantlement but completion of the termination of license.

That means the Commission basically has signed off and said the licensing has no that responsibility. An entombment was not considered a preferred alternative but it was recognized that there could be situations where it was advantageous so it was set up to be case specific and that really came about because waste disposal was not considered a significant problem if prepared at the time the 60 year SAFSTOR with the entombment with the hot internals removed.

The dose and the waste volume types of things weren't all that different. Sorry, costs weren't all that different. And the difference was that once you do a dismantlement it's gone. When you have an entombment, the public can still get dose. So that's why the other alternatives were recommended. Next slide please.

The rule requirements, this is a 1988 rule, we have played with it since then a little bit, but it's

basically the same. Significant portions of that rule are in 50.82 it deals with the license termination for reactors and it has that business about the 60 years that you have to complete the decommissioning due to termination of license within 60 years of time you permanently cease operation.

If you want additional delay, and this is for anything, it could be long or safe storage -- it doesn't have to be entombment. Then it must be health and safety reasons and approval has to be given by the commission. There were some examples given in the rule for such delay if there was no place to put the waste or if you had interconnecting systems like Indian point 1 and 2 would be an example of that.

License termination was the only it could terminate licenses unrestricted release. Later on, as I am going to talk about soon, you will see that we also have, I am sorry, unrestricted release, later on we will have restricted types of situations that we now allow. Next slide please.

The recent license termination activities the license termination rule which was recently completed and issued in 1997 it is 10CFR 20 Sub. E. And it deals with both restricted and unrestricted license terminations. The condition for unrestricted release is a sensitive individual can't receive more than 25 millirem per year. It has to be ALARA as low as reasonably achievable and that's it, no additional conditions.

For restricted release, again it has to be 25 millirem per year ALARA but put the restrictions in place.

The restrictions come in through the license termination plan. Which are those changes I mentioned in the 88 rule I believe it was in 1996.

So the restrictions come in the licensee then it is approved by NRC and outside groups, not the NRC, as part of this plan and part of its implementation, do the maintenance and surveillance and the costs for doing this are set up by the licensee up front so moneys available for what is perceived as the needed funds for maintenance and surveillance.

If the restrictions fail, then the dose cannot exceed 100 millirem per year again ALARA. And in special situations where there are additional criteria to satisfy it could go as high as 500 millirem per year ALARA. But, in that particular case, you have to have a periodic recheck that the restrictions are in place every five years. Because that's considered a temporary situation in our rule making. So every five years means temporary. Next slide please.

Now we get into current considerations of the entombment option. Can we use the entombment option right now, and if we can't what do have to do. If you look at entombment scenarios available. There is a whole spectrum of ways to do entombment, such as a very simple one that would go right into our rule making and you just take enough radio activity away, move it off site such that you could do this whole thing 60 years. And do it to restricted release so you don't have to take it down to a very low level but you can still release it. The harder one is, if you want to

leave most of the stuff there, and that's high activity stuff; and terminate the license under restrictions, because that causes problems with our rules.

For instance, you may want to just take about ten years after termination of operations and let's say, okay, now I want to terminate license of restricted release. Many of the entombment option scenarios, from the simplest one I mentioned to the more extreme one, are limited by the current rule requirements. One that I mentioned, the 60 year one, in terms of practicality in terms of savings of things is just on the ragged edge.

you have to remove a lot material and you don't really gain much. It might be some political reasons or other reasons, but it is not a big incentive. In the current license termination rule even when you use the 500 millirem upper bound again limits very many reasonable entombment scenarios. Because of the fact that you are going to be higher than 500 millirem if the restrictions failed. That's true even if you took out the reactive pressure vessel internals and Greater-than-Class-C materials.

And so it would be violation of NCFR Part 20, subpart E. The NCFR Part 20 rule when it was developed didn't have entombment in mind. It was just more concentrated on restricted release and there was this good expectation that restrictions might fail so that's why it was set up in that way that you couldn't have a 100 or exceed 100 or 500 millirems and you couldn't have very hot things because if restrictions failed then you go outside

those bounds.

So, obviously, if we wanted to use entombment in the broad sense, the entombment option, the rules would need amendments. Next slide.

Our future considerations are what will we need. These of course are possible ways, there are other ways to do this thing. But these are some suggestions. You need an enhanced information base to support the amended implantation. We looked at a broad brush type thing the book at the SECY that was given to you. Because we were mainly concerned with the viability of entombment and its practicality. It indicated that rather it is a valid thing you can in many types of situations use the entombment option, but we didn't have specific examples like in the some of the technology safety and costs series where we looked at NRC types of licensees and did detailed studies and so on. Because NRC has never permitted an entombment option. So it would useful to have some of these examples, I think, in my opinion, you could probably use some of the rule making continue with that while you were doing an information base.

This information base would be more for a guidance purposes. Of course, you need a supplemental GEIS. The one that we did earlier, one was done when no entombment was allowed and the one for license termination didn't include entombment as well. So there is a little piece missing and you have to put that in.

You could modify subpart E but the include entombment option, if you could show that system failure is

extremely unlikely to occur. Each site-specific conditions -- you would have to play with the source terms being considered for the entombment option.

And then of course, one of the important things we talk about isolation or performance assessments types of analysis. You are going to have acceptability criteria in the rule for an entombment option. In entombment, the greatest concern there is hydrological transport of contaminants through surroundings reaching the environment and dosing people.

Inadvertent true-to scenarios -- which is one we also look at if you harden the system -- it's not a very likely situation to get dosed by. But eventual break down and transport of contaminants is a more likely system.

And you could have various current criteria. For instance, you could say that you need to look at the cite for at least ten years once there is a permanent cessation of operation to make sure there is no hydrological types of entombment. But look at a realistic cost estimate or how much a licensee had to set aside and if it's a lot money based on some kind of a true analysis. You could say well that's not a very good type of entombment system, we want some system where it's really low. What kinds of facilitation or other things would you suggest to do that and if you couldn't get it down then maybe it's not the right system.

All systems that come up for entombment are not necessarily good entombment systems; pick the right ones.

So conditions have to be right or it has to be

engineered properly, or demonstrated that that's the case.

One other thing that we would have to do is revise our guidance, as I mentioned -- the entombment consideration, the way we have our rules structured now, comes into towards the latter part of our rules. The rule has a license termination stage. You can do a lot of dismantlement activities and other things prior to the license termination stage. But when you actually want to go away and terminate that license and leave the site in a certain condition, then that's a major consideration and entombment option would come in at that stage and our guidance would have to work because right now it doesn't handle entombment.

That's my talk.

KLEBE: Michael Klebe with the Illinois Department of Nuclear Safety.

I was trying to look at the agenda to determine whether or not now is the appropriate time to ask these types of questions, if there is a better time please let me know.

In terms of using entombment as a decommissioning option, how do you square that with the policy act or adopted policies of the compacts. Obviously, the Illinois policy act was envisioning not proliferating the number of disposal sites.

Obviously, the way that the country is divided itself up, you know if every one had a site, we are going to end up with a dozen maybe 15. But, if you add entombment as a disposal option, how does that beat that goal, because now

you are talking what 70. If every one, obviously, not every licensee would choose that as an option. So, how do you square that with that, and also how do you take into consideration policies of compact commissions.

We'll use the Central Midwest as an example, and certainly neither the state of Illinois nor the Central Midwest compact has any position yet on entombment. But one of the policies that was adopted by the Central Midwest Commission in their regional management plan was the prohibition. Once the regional disposal facility is developed, the prohibition against disposal at places other than the regional disposal facility. Which this would clearly represent.

Then, and I know I am asking a lot of questions, and I will let you answer them at your will. But, if you are also looking at entombment and your are talking about the viability of part 61 disposal facilities. If you take that significant waste stream away from a regional disposal facility, aren't you in essence even making them less economic? I have asked three or four different questions there; you can answer them and if I need to ask them at a different point and time.

FELDMAN: I think there is nothing wrong with asking them later on as well or bringing them up again. I'll just answer them briefly and the answer is that is something that is an issue. That there is this competition, that's set up.

One of the ways we look at this is the health and safety concern and has nothing to do, of course, what acts

are out there. But there is no health and safety concern with entombment and you are convinced that the noble thing to do.

Then some people feel there should be the option then of choosing that over other ways of disposing of waste. The other thing I'll mention is waste disposal facilities themselves and the amounts of waste they get. The decommissioning waste volumes have been getting less and less as the cost of disposal has gone up people have become very clever in ways waste and those waste volumes have. For example, way back when we did the health studies we had something like 17,000 disposals and the last assessment that was done for health BWR was something in the order of 6,000 DPUs, plus they did a lot of things [Inaudible].

Then you have people that treat waste specialized and that kind of thing and a lot of efficiency types of evaluations and that sort. So waste volume from decommissioning in general has gone down enormously because of that.

In addition, there is operational waste and that, while it's true it has been going down also, and other kinds of waste are things that go into low level waste burial grounds. There was an Appendix E or F in Reg 1496 which is the GEIS on the license termination rule, and in there is, some comparison was done for impacts of waste disposal and decommissioning waste is not a major impact based on the current rate structure. Because if you change rate structure, it will change.

But I don't think it has a major impact in terms

of its volume. Right now in terms of economics, low level waste burial grounds. That's my interpretation. Yes.

KLEBE: If I could follow-up. In the state of Illinois, we have conducted some economic modeling and taken a look at waste volumes that are being currently produced with our operating reactors. And we have come to decision in the Central Midwest it makes absolutely no sense to develop a disposal facility now given the low volumes. But, however, when you factor in the decommissioning volumes. Then it makes an engineered disposal facility economical.

You know the cost per cubic foot for us to develop a disposal facility now would be astronomical -- $900 plus range. But it is significantly less when you get those large volumes.

GREEVES: But, as I mentioned, given the current amounts of waste volumes being disposed of expected to decommissioning, those have come down significantly, so it's worth looking at that as well.

KLEBE: As I mentioned earlier, the waste volumes for decommissioning dismantlement activities have come down significantly as well. I mean operational waste volume reductions are just a reflection of the fact that waste expensive and we are doing things to cut that cost. They have done it for the decommission as well. So you need to look at that again carefully. If you have built it then you are stuck, but thinking about building it.

GREEVES: While Paul is walking up, let me just add a couple of things. First, let me thank Mike for stepping up to the mic, that's what we need, we need some

feedback, I think your questions and comments are appropriate now and later too. Your first comment about the amendments act, well, the amendments act isn't working. Any body think it's working out there? We don't have the first amendment acts site so I'm not quite sure all that is going.

Second, We do a lot of disposals currently there is a number of 20.2002 disposals that exist now, so the question of sites, yes, there is the question of not having a lot of sites, there is some disposal activity occurring under specific licenses if you are not familiar with that we can go into that. The question of 70 sites, I don't anybody thinks there are going to be 70 sites.

Look what's going on -- we are already decommissioning sites. All of the ones I have seen come in are decommissioning for unrestricted release. I think a picture of 70 new disposal sites, that's not realistic. I think an issue of this workshop is we'd like people to stand up and tell us who's interested? Is there a utility out there or a state out there that's interested in this concept, we'd like for you to stand up and speak up, cause we need that information.

This is not worth doing if there are no stockholders interested in doing it and my sense is it's much less than 70. There may be a few, we need that list. Who are those people? What is that state or what is that compact? Mike you are quite right, the compact commissions do have some control over this and as you stated, your compact has no position. I would ask you to see if you could get a position, cause I think it would be very useful

for us to know what the position of various compacts are. That's the kind of information we need to carry back to the commission there.

There kind of key textual issues that would help decide is this worth chasing or not. The economic issue -- you are quite right about the cost factor, we are quite familiar with that. There are big economic swings in this process whether you are considering big commissioning wastes. I would project that most the utilities actually are going to be sending their waste somewhere. Obviously, they're going to look for the most reasonable place cost-wise to send it, but there is going decommissioning waste.

I think, I just want kind of give some context and thank you for your comments and encourage others to stand up and let us know where you are on this issue and see Paul at the microphone. Paul.

GENOA: Good morning. Paul Genoa with the Nuclear Energy Institute and I am here to tell you that there is interest in this concept as an option by our members. We have a good representation today and I'll speak more to that later. But I think it is important you have, the commission has been dealing with a range of issues in the last few years. And I think there is a Nexus between these issues.

The fact that there are innovative ways of approaching license termination. That the terminology like rubblization and new concepts of leaving residual activity in some form on the site. The fact that people are starting to look at other than Part 61 disposal, that people are

starting looking at assured isolation concepts for long term storage and isolation of waste. That people are looking at the entombment option.

There is a nexus to this, and I think it really had a lot to do with the progress made under the low level waste policy act and other issues. I think about it sometimes and I realize that is a very large industry, the nuclear industry and it has a lot of inertia. If I could quote from a paper you will receive shortly on clearance. Nuclear technology provide significant economic and employment benefits for the United States.

An economic study conducted in 1995 by the management information services incorporated found that these benefits nationally, produced 4.4 million jobs, $421 billion in sales and $79 billion in tax revenues to Federal, State and local governments. That was in the year 1995. So there is a significant, this is about as big as General Motors as far as gross national product impact. So there is inertia in what this industry is doing, if the disposal sites are not available, then there is some other way to manage the waste and innovative attempts will be made to manage the waste safely. I think entombment is a possible option.

I agree with John Greeves that you are not going to see everyone running forward to do this approach, but we would like to know that that approach was available if appropriate. And I think that's important. We'll be glad to speak some more to this later.

But it is important to remember that the low level

waste policy act really was in direct response to an equity issue, raised by the states of Washington, South Carolina and Nevada. And the concern was that the view of the world was that there was a large industry getting larger, that the waste disposal at these three locations and at three of your locations was problematic at times, and it looked like the burden was going to grow. And there was the feeling that was not an equitable distribution. And there was no mechanism to get out of that.

I think the act that was passed put the responsibility for waste management squarely in the state's responsibility. And it recommended that a regional solution might be the right approach. But clearly, entombing a reactor is not opening a disposal site you are not going to take waste from another region and bring it to that location. But rather the local community that has received the greatest benefits from the operation of that facility in terms of jobs in terms of tax revenues and so forth and the electricity provided or the other benefits of other technologies.

In fact, they would be bearing the burden of managing that facility. And in fact it may continue to provide benefits for the future monitoring and jobs and so forth. So I think it is different and certainly it is equitable, because the burden stays with the benefit closer approximation. And certainly it stays within the state's responsibility so that's in line with the act.

Finally, in trying to move forward to decide whether the impact of the entombment option is going to

effect whether a various compact process, compact run facility will be economical. That certainly needs to be factored and I would argue that if a facility was available at a reasonable cost people wouldn't be pursuing the other alternatives. But I think there is a way to work that out within the regions. Thank you.

GREEVES: Paul, it would be very helpful to us if you could crisp-up the sum interest, you don't have to do it here, like it to be here. If we could have a good understanding of what utility sectors are interested. For this thing to go forward we need to have a sense that there is a stakeholder out there. So if you can put together some information on what that context is and define it more than some interest. I think that would be very helpful to us.

GENOA: Recognizing that this is an emerging issue and it is new there is not going to be commitments of people that have done detailed studies. But after noon when I have my opportunity to address the group I will give you some numbers.

GREEVES: That would help us know who we need to go back to and talk to about and in fact that will raise the question of what's the context in your compact. Because, as you said as issues have Nexuses. If the compact is saying we'll take a position on this and the position is we'll consider this option, that makes a difference. So it would be very helpful if you could fill in some of that information and we appreciate anything you could tell us later in the session.

GENOA: Of course, John you know with deregulation there has been dramatic change in the electrical generation industry that mergers and acquisitions move forward, consolidations occur, so if today you say that "x" power plant is owned by "x" company who lives within this region that may not be the case tomorrow. In fact, it may be owned by someone on the other side of the country. So I think we have to keep that dynamic in our mind as we move forward.

GREEVES: Do what you can. Thank you.

TROTTIER: I'd like to just echo what John has just said. It is very important in this paper that we are going to provide to the commission to be able to provide them as much information as we can. Because this is really we're to the point now we have given the commission two or three papers on the issue of entombment. They really want some meat from us.

We've been skirting the issue because we didn't have a lot of knowledge and what we are hoping to do in this workshop is get your views so that we can factor them into the recommendations that we provide to the commission. So the exchanges we have had this morning have been good. I really want to encourage that to continue. Are there any more questions for the first presenter? If not, what I would like to do is invite Steve Short to come up.

We have asked Steve to come today because he actually did a lot of the work that supported that paper that we sent forward to the commission in June. In fact, a summary of his paper is included in that commission paper. I think Steve is going to touch on some of the issues

associated with that. Steve comes to us from Pacific Northwest Laboratory.

SHORT: Thank you, Cheryl. Yes I am Steve Short the my co-author on this study was Dick Smith also of PNNL. As you are probably well aware Dick Smith and to much greater extent that myself, he is much older than I am. Has been involved in these decommissioning studies of nuclear facilities for a guess 30 years, 25 years or so and my involvement has been the last 10-15 years.

I am currently sort of management the decommissioning programs for PNNL that Dick once did before he retired.

Carl did ask us to go back because of our previous experience in looking at addressing decommissioning issues with facilities, especially power reactors. You asked us to a viability assessment of entombment. We looked at that the original studies did consider it to some extent. However, the consideration wasn't as detailed or as extensive because it was basically dropped as an option by NRC to 60 year limitation. So we have taken a look at from today's prospective. I would like to just quickly through what the presentation will cover.

I want to give you a quick summary of the paper. And then I would like you to hold your questions about that summary until I have a chance to go through and talk about how we arrived at that sort of conclusions. What we did, so what we'll go through is talk about the approach we took and the viability assessment and we'll talk about entombment experience that exists out there now. The isolation

assessment, piece of it. And then we will go a little bit into doing some comparative analysis between entombment and the other options that are available and each of those sections comes with a conclusion piece.

Basically, the conclusion of the viable assessment was that at least some reactors out there entombment, from a technical standpoint, certainly viable. If you look at experience that is out there with entombment of reactors, if you look at isolation or performance assessment that have been done for burial grounds and then compare that with what a power reactor entombment scenarios would look like you can draw the conclusion that yeah there are probably some reactors out there for which entombment could be shown to be possible and acceptable from a technical standpoint.

We also, as a part of that, also looked at the cost volume generation, dose, occupational dose, associated with decommissioning and there are some potential significant savings there. There are some caveats to that and I will get into those.

Certainly entombment does look like a viable option technically. The viability assessment approach we took was we, I want to make sure you understand that didn't go out and do any new engineering analysis or do any isolation or performance assessments or anything like that.

We took what was already available and what had already been done previously for actual sites. okay. We did look at reactors that had been entombed, we looked at isolation assessments for sites having entombment like features. I call those analogues and I will go through

those. Then we did a comparative analysis between DECON & SAFSTOR.

To start with the entombment experience. Potomac Energy Commission back in the late 1960's had three small research reactors that they entombed. Those were the Hallam Nuclear Power Facility and in Nebraska the Piqua Nuclear Power Facility in Ohio and the Bonus Facility in Puerto Rico. Each of those were entombed again about 30 years ago after only two to five years of operation. So clearly there is some major differences between these facilities and a power reactor. Currently the surveillance and monitoring ongoing being performed by DOE. They do it once to twice a year. They go back to those sites and do some radiation surveys, ground water samplings, soil sampling. The cost of that 15-25K per year. Each at less than 300,000 curries left in the entombment structure, that's an order of magnitude less than power reactors, at the very least. Each currently now is being used as a non-nuclear site and I will talk about that. I don't want to spend a lot time going on these, but I did want to lay them out so that you can understand and see what is currently being done. The Piqua Nuclear Facility was a 45 megawatt plant. It was a organically, this was back in the time when AEC was doing research on different types of reactors and so this was an organically cooled moderated plant. It only operated from 1964 to 1966 and it was entombed between '67 and '69. It had approximately 260K curies at the time of entombment. The basic design of that facility, that entombment facility was the reactor vessel, and spent fuel storage pools were

left in place. Most of the internals were removed and disposed off site, but the thermal shield and some grid plates and some of the lower activity internals were left. All vessel penetrations were seal-welded and the vessel spaces between the vessel and cavity liner and the pool were filled with sand.

Once the vessel and the pool were filled with sand a two steel plates were placed over the reactor and seal-welded down. That was prior to placing some waterproof barriers between the reactor vessel and the steel barriers. Re-enforced concrete slab placed over the top. The reason they did this is because they are still using the containment as a warehouse. The city of Piqua is. The auxiliary building is still being used as a office complex. So the rest of the facility and buildings were decontaminated, the surfaces above the operating floor were decontaminated and are currently being used. Each of these facilities also used time capsules and warning plaques that were placed over the reactor or near the reactor.

Like I said, the annual survey that is performed, this particular facility they have never detected anything significant, about 20 years ago they did, Carl can you put the next slide up just quickly.

This is not a very good view graph, a very good picture, but you can see this over here is the reactor and this is the pool and these are sumps. Twenty years or so ago they did find some water sludge in those sumps that were slightly contaminated, those were removed and since that time they haven't. So contamination levels have been low,

again they are using this area here as a warehouse, using this as office. The basement is still assessable. But the rest of this all filled with sand and been sealed in place. They are expecting to have to maintain surveillance on the facility for 120 years or so.

Go ahead next panel member. Another research experimental reactor the old AEC days is 256 megawatts. This was all liquid sodium cooled graphite moderator reactor. It operated only two years '63 and '64 then decommissioned in the '66 to '69. It's inventory at the time of entombment was about 300,000 curies. This is a much more sophisticated facility than Piqua so if you could throw the next graph. The picture of this facility.

This is the reactor building, basically the reactor is right here and it was a fairly bulky structure because it was graphite moderated. All the reactor internals were left in place. The reactor was seal-welded off, not backfield any grout or any sand or anything in particular. Many of the pits were backfilled with grout. The contaminated materials from the rest of the site were put into those pits and then they were packed with grout. The cross-trench area is what is still in place. The reactor building was removed and a waterproof barrier was placed over the top that is several meters thick, various layers of sand, clay, polyvinyl, waterproof barriers, water collection trench built around the barrier.

The thing that I want to note about this is the far end of the building was a turbine generator hull, that facility is still being used as the site was repowered as a

coal-fired plant. And so they are still using the turbine generator part of that facility. The rest of this is all under ground like I said this is all gone now. They did do an isolation assessment and that isolation assessment showed nickel 63 as being the principal isotope. They evaluated that over several thousand years and never showed it to come any where near what they considered the maximum permissible concentration water at that time which was taken from part 20 for discharges from power plants.

They also do a semi-annual survey, the DOE does. The DOE basically contracts with a the Nebraska Department of Health to do that. Several years ago Nebraska requested, and the DOE granted the installation of 16 ground water monitoring wells around the site. So those are now sampled semi-annually and radiation levels taken above the engineered barrier over the reactor and then soil samples are also taken. That's about 25K a year but that is also sampling costs. okay.

Finally there is BONUS. BONUS is not a real good example of an entombed reactor, in my mind, but it is still in place. They did do some things to leave it with the intent of leaving it there. It's a 50 MW plant. BONUS what it means it was a super heater reactor. So they recycle the steam to super heat it. It operated for five years between '62 and '68. It was decommissioned between '68 and '70. It only had about 5,000 curies at the time it was entombed. If you will put the facility diagram up there.

Basically the only part of the structure that was entombed, the isolation structure is this reactor, the

reactor itself and the pool, right there. The rest of this facility was cleaned, decontaminated. So this facility is still in place, you can go on the web site and see a nice picture of it. It sits right on the western shore of Puerto Rico, very beautiful location. Basically, the reactor pressure vessel and internals, except for the control rods, were all left in place. All penetrations into the structure were filled with grout and seal-welded. Then the pump room for this particular facility is below the reactor and that filled with contaminated materials from the rest of the structure and then filled and sealed with grout. Then a reinforced concrete slab was installed over the top of the reactor and pool. Again, time capsules and warning plaques were installed to show the next picture, this is a picture of what it looks like now.

This is that structure that I was just telling you. This is the reactor, and this is the pool. They currently have plans to turn this facility into a museum. Although they may have problems with that. This is the one site where it's not an especially good example of an entombment facility because the design has allowed periodic flooding into the basement surrounding this structure and they do have some contamination, some low level contaminations in the facility due to flooding in 1996 and then again last year as a result of hurricane George. But they are planning on turning, next year actually. I want to talk a little bit about the entombment of. Conclusions.

A good design and an implantation of entombment can result in fairly minimal long term monitoring

requirements. That's of course a big issue for entombment of power reactors and exactly what would be required for long term monitoring and surveillance. But for these facilities, especially those that the first two pick one, Hallan, it's fairly negligent. There is a very low likelihood of problems developing later, if you adequately seal-off the contaminated structure from the environment. Some of the good design, a good design might incorporate filling of contaminated and empty spaces with grout. Filling and sealing penetrations both into the reactor vessel and into the entombment structure so you have a double containment. Then sealing off access to the below grade structure. This is really where I would like to focus the discussion, because this is what will drive whether entombment is ultimately acceptable for any given site. The entombment isolation assessment. Again, I want to emphasize we did not actually go out and do an isolation assessment for PWR or BWR. We used, what I call analogues and factors to select those analogues were their inventory, comparable to greater than what you would see in an entombed reactor. Physical ground water barrier integrity. Basically your isolation structure and vault the engineered barrier, similarities, chemical and physical form of radioactive isotopes, how soluble are they. A transport mechanisms, the fusion evocation, they are relative importance and then scenarios for evaluation. Residential farm, family and inadvertent intruder. Based on those factors we selected the following analogues. The grout disposal facility, that's located at Hanford, the state of Washington. Salt

Stone disposal which is located at the Savannah River and then the Navel Reactor Burial Ground which is also located at Hanford.

Just a comparison of inventories, the Naval Reactor, the only radio isotope evaluated in their performance assessment was nickel 63 and 59. All but about 7 or 800 of that nickel is 63. The point I want to make here is a sort of compare that inventory what you would find PWR typically and without GTCC it's significantly less with GTCC it's quite a bit more, Greater-than-Class C. I'll just back up a moment if you are looking through the inventory, you'll see the differences between these facilities, fundamental differences in purposes of these facilities are PWR the Savannah River was a Tritium facility so you see significant quantity tritium and waste disposal. Hanford was a plutonium protection facility so you will see a lot of fission products, significant quantities of fission product. That's important because fission products, tritium tend to be more mobile than your activation products that you will typically find in a PWR, nickel, cobalt, iron, which is on the next page, but don't worry about that yet. Anyway, so from a grout disposal facility prospective, lots of strontium 90 and PWR lots of cesium relative to PWR.

BYRNE: Before, my name is Jim Byrne from GP Nuclear before you go away from that slide, I don't understand the basis of your PWR activities there. You just talked about activation and the vessel or are you talking about total PWR?

SHORT: The assumption on this slide was that

there was decontamination of the for the aggressive decontamination of the primary circuit to remove and the surfaces external to the reactor region itself to remove cesium contamination that may exist or corrosion product contamination in the pipes and that kind of stuff. So that's what these inventories assume. So what we primarily got here is, but even if you leave, I think a point is that is even you don't do a significant amount of decontamination, cesium inventories left in the PWR would be significantly less than what you would see out here. Okay, and vision product inventories would be significantly less than you would see in these two facilities. Okay, that's sort of the point I am trying to get across here. Go ahead Carl.

Again the PWR largest source of inventories of Cobalt and the iron. Total inventories are as you can see Grout disposal facility in Hanford is up in the 17, 18 million courier range, Salt Stone disposal facility significantly lower, but it does have some highly mobile. PWR and BWR total most of it is cobalt 60. Go ahead Carl.

Engineered barriers comparison Naval reactor burial ground if you are not familiar with that the Navy is burying the Naval Reactor vessels from submarines and other surface ships at the Hanford site. They basically cut the reactors out the submarine and then fill those reactors with grout, dispose of those and there are 120 of them planned. Currently they have disposed of about 80 - 85. Grout disposal facility and the Salt Stone disposal facilities, both of those are reinforced concrete vaults on the order of

three or four feet thick. Important point I want to show about this slide is that it did take credit in the isolation assessment. Generally the degradation or corrosion rate in the case of naval reactor vessels. Corrosion of the steel pressure vessel, the others its degradation of the grout, the reinforced concrete vault, itself and the grouted waste barrier to it. The assumptions that are made, I don't want to get too caught in those, but they are considered very conservative, from their perspectives. Site characteristics, there are some significant differences between he sites that I used for my analogues, and what you might typically find for a reactor. One is the distance to a river. Burial grounds you tend to locate those as far away from rivers as you can and this points that out.

Most of the reactors in this country are located within a mile or two to a river. Depth to ground water again, the assumption is well at these sites its fairly deep depth, except in the case of Savannah River. Again since most reactors are located fairly close to rivers, the depth to ground water is fairly shallow, not very deep. In many cases there is very little depth. But in other cases it's you know, I would say Palisades, for example, Prairie Island, depth to ground water could be 150 feet. Pardon. Palo Verde is a good example. Recharge rate. Recharge rate is significant input into the performance assessment that's the rate at which water down through the disposal site and into the ground water where it will carry contaminants into the ground water for your dose assessment.

Hanford site is a very dry site, very low recharge

rate, Savannah River is the high rain site, so the recharge rate is significantly higher. Those ranges should encompass most of the site, most of the reactor sites in the country and then soil types. I tried to pick a couple sites that had vast differences, ones that very clay type soil and other very silty, sandy type soil. I throw this up just to show just what the performance objectives were from DOE. These are taken from DOE Order 5820. But there is a difference between what is required in that order and what the programmatic performance objective was. The requirement is usually a 1,000 years. You've got to look at it through the first 1,000 years. The performance objective was to go through 10,000 beyond that there is a lot of uncertainty. But, performance objectives were generally 25 millirem per year for your farm family and residential family that's comparable to NCR 20 subpart E. They also had some population scenarios that they consider which NRC doesn't. Inadvertent intrusion scenario, they've got both an acute and chronic objectives. The acute being an instantaneous exposure and the chronic being a long term exposure over a very long time period. Then a ground water resource protection from a 4 millirem per year. That's the same as what EPA's restriction is.

I'll just quickly go through the results of the naval reactor. Again, the only real isotope the value weighed the nickel. The don't come any where near the 25 millirem per year. Nickel is not very mobile in the environment. Although nickel 59 can present an exposure issue and external issue and nickel 63 will present an

internal if it's taken up inside in a dose problem. But, their isolation assumptions about the durability of the structure and its mobility they don't come anywhere near the 25 millirem per year. They did do the ground water. I think that in all of these you'll find that ground water drives the dose generally it is the greatest source of dose. The grout disposal facility looked at a variety, and actually analyzed each of the different scenarios.

Farm family, residential family again 25 millirem per year was the objective and below that. The only case where they had a scenario where they exceeded the ground water resource protection requirement 4 millirem per year was. Well, they had one scenario where they exceeded the 4 millirem per year, ground water resource. Salt Stone disposal facility. This is a little bit different than what you've got in your view graph. Basically, I had this number here, up here, those are, I initially was looking at those as farm family and residential family, what they really were is a farm family residential family with an intruder assumption.

Okay, so I moved that down to here, they looked at this as the bounding case and didn't evaluate those separately. In this case, they basically assumed that farm family used the disposal site as a foundation for their home, their farm. So they had the external intruder assumption, though assumption, then failure over time period resulted in contaminants getting into the ground water and so they had the pathway and soil pathway. Pardon. Pardon me.

Again in this case they had one scenario where they exceeded the 100 millirem per year. In the ground water they never showed any scenerios that would exceed their performance objective. In each of these cases, they assumed the 100 year institutional control period after which degradation of the structure began. So conclusions. I guess sensitivities. Any isolation assessment apply retardation factors to individual isotopes conservative assumption there is no retardation. Non-conservative assumption is that there is some retardation.

Each of these cases again they took credit for natural retardation, migration or natural retardation factors in the soil and the grout and depending upon what you assumed there it can have a vast difference, give you a vastly different result in what your performance assessment output would be. Recharge rate. Like at Hanford would vary between 0.16 and give you vastly different results in what your performance output shows.

Then the degradation rate, how long you can take credit for those engineered structures that has a significant input into what your final output would be. Those are really the key drivers in key assumptions in what your output and what your results will show on your isolation. Conclusions.

The analogues where shown for the most part to meet the performance objectives and the case of Salt Stone disposal facility, it currently is being implemented at Savannah River. The grout disposal facility at Hanford, that project was canceled, not because of the performance

assessment results but because of concerns about retrievability issues and the state of Washington had some retrievability concerns. Like if you had a problem at some point and you need to retrieve it. I didn't show you diagrams of the vaults, but these vaults are very large, on the order of 30 meters long by 15 meters wide and 10 meters high. Ones that Savannah River are even bigger. Inference towards our final conclusions, based on the fact that par reactor inventories tend to be significantly less, especially for those isotopes that are more mobile.

Site characteristics of the analogue sites, I think encompass for the most part the sites power reactor sites. One big difference again is the surface water difference. That tends not to be a driver in your performance assessment, it's the ground water that tends to drive your isolation assessment results.

Entombed reactor structure design is similar to those concrete vaults used at the other facilities and a performance requirements are similar 25 to 100 millirem per year, or are expected to be similar to NRC would require. Some issues that really need to be addressed, if you are going to proceed. Again site characteristics and how does that closeness to surface water play-out. Again, I don't think it will be a big issue, because the ground water will drive your peak dose. Surface water is a population exposure input. If you assume some sort of population around this facility over some time period. DOE evaluated populations.

Entombed reactors have if you left the

Greater-than-Class C in the reactor, I don't think we draw any conclusions at this point. Other than to say that nickel tends to be a low mobile isotope, not very mobile. It's inventories were quite a bit larger than any of those I looked at. So I didn't want to draw any conclusions about what a facility with Greater-than-Class C left in it whether it would meet performance objectives.

Another issue is that power reactors tend to be above grade for the most part. Each of the facilities we looked at were below grade, by at least five meters and had five meter of over burden, except for Salt Stone Disposal Facility and Savannah River. If they went that deep they would be in the water table. But the Hanford ones were five meters deep, the ones at Savannah River are still below ground.

Reactors will be above ground, and Dick will talk some tomorrow about this in his presentation but it can be above ground by significant amounts.

So how do you build an entombment structure from a power reactor facility that would discourage inadvertent intrusion and then another point is that each of these, the isolation assessments for each of these facilities did take some credit for the engineered barriers being able to provide some resistance to migration. The results would be significantly different if you could take actually no credit for any of that engineering opinion. So that would be an issue that would need to be dealt with.

The comparative analysis basically looked at the costs in the revised studies for PWR's done in the early

90's compared those, the results of the entombment a quick analysis of what we think the entombment costs those waste volume would be and compared those and you can see that we looked at two different entombment scenarios immediate and delayed.

Cost ranges reflect differences on assumptions on what the cost of long term surveillance and maintenance monitoring would be. In this case it was over a million a year, this one here we assume about 400,000. Excuse me, and the low cost is about 400,00 a year constant dollars the high case the assumption a little over a $1,000,000. Big issue there is is how much insurance, if any, do you need to maintain on this structure. Liability insurance, that kind of stuff. So there is a real issue there.

But so you look at the cost, you can see that under the entombment scenario costs are very comparable with SAFSTOR and can be quite a bit less if you get DECON. Low level waist disposal volumes can of course vary significantly from the immediate DECON and then can have a significant savings in dose also. We assumed 130 year surveillance and monitoring period. That's much longer than you need for cobalt in that case we did assume that there was some cesium left and we put 130 years out of 4 or 5 half lives cesium. Next slide.

I guess we went through this already, but cost savings can be up to forty percent; volume reduction can be up to ninety percent -- you don't have to just send it off to a disposal site. Occupational exposure reduction can be up to seventy percent, and on that one you'll have to be a

little bit careful; it depends on what you, what you do to, how much material you take and put into the entombment structure and what you've gotta do with that material -- how much cutting up and partitioning you've gotta do.

There isn't much savings over SAFSTOR. Just a little bit, if you assume a sixty-year safe storage period. And again, the big issue here is, is what is the cost of that long-term surveillance and monitoring. And I think if -- can you just through that final, Conclusions graph, slide back up? No, the, the one right at the very front of the presentation. I should have put another one in there.

TROTTIER: At the front of the presentation. Just turn it over, go all the way to the front.

SHORT: Yeah -- no, before that. Way at the very front. It was a summary conclusions view-graph.

Basically the summary conclusions were that based on using these, these analogs, you could conclude that at least, if, you know, if you didn't leave any grater than Class C in the entombment structure, many reactor -- there certainly are those reactors out there that you could show would meet performance objectives of, on the order of 25 millirem per year.

That's not it either. But -- and then --

TROTTIER: It's the third slide.

SHORT: Yeah, that's fine. I guess that's basically what I wanted to summarize and conclude. Again, you have a copy of the paper that we prepared, and the paper cites most of the references. So if you want more detailed information, we could talk about it afterward or obtain

those references. And I guess I'm ready to open it up to questions. Yes, sir?

GUNTER: Paul Gunter, Nuclear Information Resource Service.

SHORT: Sure.

GUNTER: In your overall assessment of radioactive inventory, did you, what kind of assumptions did you use for fuel performance history?

SHORT: Well again, what we assumed was, was that you had done significant decon to remove any fission product inventory that may have been scattered around the primary system. So, very little -- as you saw, very little fission product inventory remained. One of the -- and -- but if you looked at cesium/strontium inventory left as a result of a reactor having, you know, some severe fuel-failure issues, you would not -- I do not believe that you would come up with anywhere near the inventories that were in the Hanford grout disposal facility. So the inventories for cesium and strontium are significantly less, even in a reactor that's had fuel failure problems and left cesium behind.

And if the assumption was made you didn't clean that up, I'd say maybe at the most, a few hundred to a couple thousand curies would be left, maybe at the most. And that doesn't come anywhere near what the assumptions, what the inventories were that were analyzed at the Hanford facility and the Salt Stone disposal facility.

But for this comparative purposes, we didn't assume that there was -- we didn't look at any cesium being left. Yes sir?

GENOA: Paul Genoa with NEI. Steve, I want to compliment you on the study. I think it did bring out the key issues that we need to discuss. And it brought, two questions came to mind. The first is, just right where you're talking about, the assumption that aggressive chemical cleaning would be done prior to this.

And of course, in our recent decommission experience, aggressive chemical cleaning has been very successful for rapid dismantlement, and I wondered really whether your analysis showed that it would pay the same kind of dividends in an entombment scenario, or you're really just chasing down activity that's gonna decay away during the entombment process. Is it removing significant amounts of long-lived isotopes to where it would still be of value, or is that research still left to do?

SHORT: The chemical decon?

GENOA: Yes.

SHORT: Uh, it wouldn't remove a significant amount of long-term stuff. The major long-lived isotope in reactors is the niobium. You'll have some of that in the corrosion product, but most of that inventory will still be in the reactor vessel and internals that you may leave onsite. So the inventory that you'd remove through any chemical decon would be small relative to what's still inside the reactor vessel.

GENOA: And that leads me to the second question.

SHORT: Okay.

GENOA: And that is, on the assumptions used in your study for the greater-than-Class-C material that would

be in the reactor vessel, in both cases you assume the removal up front and then varying treatment on the facility after, whether it's entombed early or entombed late. And I wondered whether there was any analysis envisioned to look at -- or perhaps you already have looked -- at whether you could leave, essentially, do you active monitoring, seal off the facility, active monitoring, and then removal of the greater-than-Class-C components after fifty or a hundred years? Would there be any ALARA savings? Any occupational dose savings by removing them later? Or in fact are you still gonna need to do it underwater, and that poses other problems?

SHORT: After a hundred and thirty years, when most of the cobalt-60 is gone, a significant amount of your dose is gone.

GENOA: So I guess that's what I was looking at. Is there, is there a dose savings to the operators in removing the material --

SHORT: If you wait 130 years, there will be, yes.

GENOA: Okay. So that would actually be perhaps a third option within the entombment within the entombment approach.

SHORT: And we looked at the delayed entombment. The delayed entombment scenario assumed that you waited 130 years before you removed, or actually entombed, the structure.

GENOA: Right, but in that assumption, you removed the greater-than-Class-C components right away.

SHORT: I don't -- no, we did not.

GENOA: Well, maybe I have that wrong. I'll go back and check it. Thanks.

SHORT: Yeah, sorry. I don't believe that's correct.

HANSON: My name is Bob Hanson. I'm with the National Low-Level Waste Management Program working with greater-than-Class-C.

SHORT: Okay.

HANSON: And on the cost study -- and I think we, maybe we just kinda hedged around the question I have -- but you had immediate entombed/delayed entombed and you showed the cost being kind of comparable with decon removal. And I assume those are, those are reflecting, leaving greater-than-Class-C, or taking greater-than-Class-C out first. And if so, did you look at it with leaving greater-than-Class-C in on a cost-savings basis? I mean, obviously dose is a big issue with greater-than-Class-C, but I was just curious too.

SHORT: Right. On the immediate entombment, of course we remove the GTCC immediately. And there's not a significant dose savings because you have to deal with those things, okay, right up front. In the delayed entombment case, we assume that you didn't deal with it until the end of the life, which is the reason for the significant dose savings. I mean, significant dose savings on the slide there, for delayed entombment. So we assume that the GTCC stayed there for 130 years. I think that's right -- isn't that right, Dick? Okay, maybe I'm wrong. Sorry.

GREEVES: Why don't you take a look at it, and

maybe this afternoon clarify that picture.

SHORT: Okay.

GREEVES: All right.

SHORT: Sir, go ahead.

GENOA: Paul Genoa, NEI. Just for clarification, on page 11, "delayed entombment", immediate removal and package the vessel activated internals for storage and/or offsite disposal, which may very well be the right assessment. And I'm just wondering whether an assessment was done of removing the internals late, later in the entombment.

SHORT: Well, I think what we just decided is that we need to go back and look and see what our assumption was there, because I don't recall off-hand. I thought we had done it later, at the end of the 130-year period. Dick doesn't think so, so we'll go back and --

GENOA: Clearly, to do it initially, you have to do it underwater.

SHORT: Yes.

GENOA: It's not clear to me, at this point, late in life, whether it still would require that type of remote handling, or in fact whether there'd be some time-saving of going in and removing it without the need for remote operation. Thank you.

SHORT: Right. Could you go to a microphone.

SMITH: When we did our original studies back in the late '70s, the PWR, that was of course for a machine that had run its entire, I suppose, forty-year life at 75 percent efficiency and all that sort of thing. So that was

really hot. The internals, the hottest part of the internals in the greater-than-Class-C material, after the cobalt decayed away, still had a residual dose rate of something on the order of one rem per hour. I don't think you'd care to send people in there very long, though you probably would still have to do it underwater. That creates real problems with trying to do that 130 years later.

GREEVES: Dick Smith. For the record -- as we go to the microphone you need to identify yourself, and I believe that was Richard Smith. Okay.

BYRNE: Jim Byrne from GPU Nuclear again.

SHORT: Sir.

BYRNE: We're in the process of decommissioning a research reactor at Saxton -- John mentioned it at the beginning of his speech.

SHORT: Yes, sir.

BYRNE: It's been shut down for 25 years. We operated it for 10 years -- 4,000,000 curies at shutdown. Now a couple of things here, when you looked at what your peak was and your things like that there, there's real small activity, it didn't operate very long. But Saxton was sitting there for 25 years without any appreciable corrosion to the vessel or anything like that. And these long-term shutdown reactors are something else you should look at when you do your entombment considerations, because we didn't do any special things for Saxton. We let it set there. We didn't fill it with concrete or anything like that. There's no corrosion. There's no problem with that.

The second thing, we pulled the vessel 25 years

after shutdown. We just pulled it and shipped it entire down to Barnwell. I mean, a lot of people aren't gonna have that option again, of letting this thing sit, let these decay from having them come from TMI 2, where I cut up internals inside the vessel. When you first shut down, even for a short period of time, that's a dirty job. You don't want to do that, in my opinion.

SHORT: Right. Well, especially for a reactor that's had an accident.

BYRNE: Well, even a reactor that has a lot of activity in it -- Yankee Rowe did it, and they had a lot of problems with cutting their internals.

SHORT: Sure.

BYRNE: Late in that period of time, it saves you a lot of dose to do that job.

SHORT: I know. Of course, Yankee Rowe and Trojan, their objective was to get their vessels off to a disposal site before the disposal sites disappeared. That was part of the argument for immediate decon. But their arguments for immediate decon was to get rid of the liability. There are trade-offs, yes. Any other questions?

GREEVES: I've got a couple of comments. This is kind of freeform. I think that's the beauty of workshops.

John Greeves. I don't know. I look at these numbers in terms of costs, and maybe I don't understand this chart, but the numbers I'm seeing coming for the industry for decommissioning are much higher than this.

SHORT: Yes, they are.

GREEVES: So what I'd invite the industry to kind

of do kind of do some truth analysis of these numbers. We, you guys have hard numbers on these costs. If you could get together with us and do a better job of identifying what it really costs to do these decommissioning scenarios, that would be real helpful.

And second, this business of only maybe coming up with a forty percent savings over decon. I don't know -- I don't find that too exciting. This is gonna be a controversial issue. So, I'd like to hear from the industry. You want to take on this controversial industry for -- you know, if it was an order of magnitude, I could see you jumping on it. But for a fraction? I don't know, Paul, whether you want to address that, but I'd over time urge the people who want to do this to address, what do you see the pay-offs being? Because I think there's some question about the cost figures that we're looking at. And if it's only a marginal cost improvement, do you want to really take this thing on? I'm just throwing out ideas, Paul. I don't know whether you were stepping up to help with that issue, but go ahead.

GENOA: Paul Genoa, NEI. John, perhaps I'm coming at it from another angle. And I think the economics of the issue need to be understood right up front, and there may or may not be advantages. And that depends a lot on the assumptions made on whether low-level waste disposal's available, at what cost. But I think that's really the issue: is it available? There's a need for regulatory structure to allow for entombment because there may not be disposal available at some point, and you're going to have

to act.

The industry never expected to store spent fuel onsite for the foreseeable future. And yet, now we have had to invent a regulatory structure to allow for ICFSE storage, and we will be monitoring that for a long time to come. We never envisioned entombing our reactors, but the fact is, future disposal is uncertain and appropriate contingency planning is -- I think that, I applaud you for even looking into it at this date but we need to have that in place should the eventuality be that there is no disposal capacity available.

But somewhere along the line, there's some economics. When we're saving hundreds of millions of dollars for decommissioning today and trying to accomplish that within a forty-year window, when you start to take that window out to a hundred years, you can start to see that perhaps the power of compounding allows for a very differential accumulation of those funds.

GREEVES: I just would invite you to provide some perspective yourself in terms of what these numbers are for decommissioning because as I said, the costs I've seen coming in are much higher than these numbers and maybe I'm just not quite understanding the chart here. But I think that's an area that we'd appreciate some additional engagement on. Okay?

GREEVES: Sir.

SHERMAN: I'm Bill Sherman. I'm with the Vermont Department of Public Service, and I am slated to be on a panel and have some comments about the economics of this

endeavor, which I'll await the panel discussion this afternoon, but only say, now, in response to your question, John, about the forty percent, I represent rate payers. And forty percent of $500 million, $200 million, almost is real money for the rate payers that have to pay for this. Thanks.

GREEVES: Good. The numbers that were on the chart weren't $200 million and there's gonna be a cost of going down this path. I would expect there's probably some people in the audience that oppose this particular approach. So there's going to be a cost in going down this path. There's going to be a cost in terms of us developing even a regulation, and I think we just need to understand what, what the benefits are. I didn't mean to belittle numbers of forty percent.

[Laughter.]

GREEVES: But frankly, when you add in the efforts to come up with such rulemaking, the time to do it, etc., I think the people that are looking at it need to at least think about those issues and help us understand what those costs are. So I, we need to examine this from all sides. We haven't heard a lot from people that oppose this. I expect we will, either now or in the future, and there's a cost in carrying that forward. So --

FELDMAN: Carl Feldman. I just want to make a quick comment. One of the things that was not really talked about very much on the long-term surveillance and maintenance was, once that license is terminated and the entombment is done in a proper way, the expectation is that

those numbers would be very low. That really wasn't factored into Steve's analysis because he didn't have examples of that, and that's something that industry perhaps could give us some information on. And I would expect it to be significantly less than what was used in those figures.

HELMINSKI: Ed Helminski of the Radioactive Exchange. You didn't mention anything having to do with toxic content of this material. Under -- I know that EPA is raising these issues. What happens in the long-term with an entombment facility, as with -- people are talking about rubblization. You end up having a RCRA mixed-waste facility. How are you going to deal with that? Are we going to have a hazardous waste facility that we have to deal with? You know, I know "EPA" is a bad word at the Nuclear Regulatory Commission -- but how is that being factored in, into NRC's analysis of what EPA may have to say on these long-term options? And did you look into, in the DOE facilities that you've looked at, did you look at how they've dealt with it? Because, EPA does have a regulatory -- well, actually oversees all of DOE activities.

SHORT: I guess I'll answer that question. The analog sites are all regulated by DOE and by the states and by EPA. And each of those organizations concurred upon the results of the performance assessments that were done, okay? And I didn't address the hazardous piece of this because it's not clear to me that in an entombed reactor facility, there is a hazardous waste issue. Okay?

But in terms of the Salt Stone disposal facility and the grouted disposal facility at Hanford, those all had

significant reg -- State of Washington, State of South Carolina, and EPA involvement in those analyses, okay, and ultimately they had to accept the final proposed solution for those wastes, those particular waste volumes. So they were involved in those and they did do, they did do an analysis of the chemical, the non-radioactive chemicals that were in those facilities. And I didn't look at that here; we didn't look at that in the analysis we did, because it's not clear to me that we have a hazardous waste problem with an entombed reactor facility. So --

HELMINSKI: I know EPA's raising those issues with rubblization. That's why I bring up the question.

SHORT: Okay. I guess I'm not familiar with why there's an issue there with, even with rubblization. But I'd have to look at that some.

HELMINSKI: Can I ask John?

GREEVES: EPA has made some comments about that, but they haven't -- we've invited them to provide us a paper on it, and so far I don't have such a paper. You've got utilities in the audience, and they know this better than I. But I think their first action is to try and remove the RCRA question and remove those types of wastes and have it not be an issue. Granted, it may be but I think the utilities can stand up -- do they see RCRA as a long-term issue at these facilities? Or do you expect you'll be able to remove the RCRA type material? And I have some familiarity with the Hanford disposal vault. And I believe that was evaluated under --

SHORT: RCRA.

GREEVES: -- the EPA approach. So, one, you can get to the end of the process. It's just that you'll have to deal with multiple agencies. So it, that process is available. My expectation is, the utilities would, to the extent they can, like to remove the hazardous material and I, that's the approach I've seen at the reactors we are looking at. And in fact, I'd invite the utilities that are brave to step to the microphone and confirm and they expect to, in most cases, be able to remove the RCRA component. But if not, we'll maybe get some more comments on it.

BYRNE: This is Jim Byrne again. I'll be brave. We went in -- one of the first things we did in site characterization, was determine whether hazardous materials were left in the site, and we removed those materials and got rid of them. Almost the first thing we did was do that, before we deal with the nuclear regulatory issues with the site at Saxton.

SHORT: At Saxton. Okay.

GREEVES: That's been the experience I've seen out there, is that they have been able to remove the RCRA components. And I think that's their expectation. So I appreciate Jim standing up and giving us a data point on that. And if EPA comes up with some comments on these new emerging concepts, we'll factor them into this Commission paper and others that we present. And that's the purpose of these workshops. So thanks for bringing those up, Ed.

SHORT: Any other questions?

TROTTIER: Thank you, Steve. I think that was a really good conversation. And as you might notice, we're

way off schedule.

I'm going to make the offer to our guests from the United Kingdom -- would you like to go on now or after lunch?

WOOLLAM: Whatever's convenient.

TROTTIER: Well, I'm only thinking about my view that about two hours is about all people can stand to sit. And we've been sitting close to two hours. I think my proposal is that we break for lunch so that people are refreshed when they listen to you. And that's what I'd really like to have happen, rather than people wanting to get out of here. So what I'm gonna propose is, it's ten minutes to twelve. If we could be back at one o'clock, that gives you roughly an hour. I realize that doesn't give you a lot of options. There are several restaurants in the area. For those who are not familiar, there's a Chinese restaurant next-door. We have our wonderful café upstairs and there's Chili's across the street -- roughly across the street, catacornered across the street. And those are probably the best bets, rather than venturing any further for an hour. But I would like to see everyone try to get back roughly one o'clock and we'll try and get started then. Thank you.

[Whereupon, the meeting was recessed, to reconvene at 1:00 p.m., this same day.]

A F T E R N O O N S E S S I O N

[1:04 p.m.]

TROTTIER: Good afternoon. I think we'll go ahead and get started. I just wanted to try and be as close to one o'clock as possible. What I'd like to do before we start is to mention that we did make copies, which we didn't realize we're missing from Steve's slides when we made copies, and they're on the back table. So if you would like to have a copy of the figures from Steve Short's presentation, there are copies back there for you. Carl, are there any other -- okay. And for Dr. Woolam's presentation, Carl said we will need to make some copies of them also.

What I'd like to do now is introduce Dr. Paul Woolam. I'm really pleased that he was able to come over here for the presentation. He comes to us from British Nuclear Fuels, where he is the strategy and assessment manager. And his role is primarily to manage the production of their strategies for decommissioning. And they have 26 reactors, so I think he has a lot of real useful information to give us. And at this point, I'd like to welcome him to the United States.

WOOLLAM: Thank you for your welcome. Can everybody hear me here? Yes, good.

I'm very pleased to be here. I notice the NRC has even organized the weather to make me feel at home.

[Laughter.]

WOOLLAM: All we need now is a little bit of fog and it will just complete everything nicely.

The central question I think we're discussing today is whether we can safely and cost-effectively defer dismantling decommissioning reactors for a significant period into the future. In the UK, the decision is actually made easier for us because we have no disposal routes, and therefore, we have no choice.

Strategically, in the UK we plan and, therefore, finance for future dismantling because we think that's the prudent and responsible thing to do. But this doesn't actually foreclose our options into the future. We could readily change our strategy to do what we in the UK call in situ disposal, which is I think is the same as what you in the U.S. are calling entombment. We see no problems with deferring dismantling, provided that future generations are left with the money to do the job and adequate records of the plants.

Now I've been asked to tell you something about the British strategy for reactor decommissioning. Because our systems are rather different from yours, I thought it might be helpful if I quickly gave you some background to the UK nuclear power industry.

As Cheryl says, we've got a large number of reactors in the UK. In total, there's 40 gas-cooled graphite-moderated units. There are only two commercial nuclear power licensees. One is BNFL, which owns 26 units on 11 sites, and the other is British Energy, which owns 14 units together with one PWR. And in the UK, about 30 percent of our electricity is generated by nuclear power.

Now, our gas-cooled reactors are physically very

much larger than the water reactors that you'll be used to seeing. They're typically 65-foot diameter steel pressure vessels. The vessel and the core together weigh about 5,000 tons, which means that we have a very large and complex on-site dismantling job. There's no way that we're going to be able to pick up a 5,000 ton vessel and core and move it off to a disposal site, as you did at Trojan.

We also have people living just a few hundred yards from our reactors, which again I think is slightly different to the situation you've got here. And in many cases, we've got large centers of population within just about a mile of the plants.

We don't have the spent fuel management situation which you've got in the U.S. All our spent nuclear fuel gets reprocessed at Sellafield. Our reactors will be defueled within about three years of shutdown and all the fuel will be shipped straight off to Sellafield, and there will be no extended onsite storage.

However, we do have a major waste disposal problem. We currently have no disposal routes for most of the activated decommissioning waste. The UK government policy is for deep geological disposal, but we don't expect any facility to be available to us for several decades. In fact, in the UK we're planning that there'll be no disposal route available for the best part of a century. And when it does come, the expectation is that reprocessing waste will be disposed of first. Currently, we've only got the facilities to dispose of waste, which is typically at the sort of levels that you would send to Envirocare in Utah.

UK government did a policy review in 1995, which identified that SAFSTOR was a potentially feasible and acceptable decommissioning strategy. We also have to review our strategies and the safety cases every ten years during the decommissioning period, and along with that, the strategy has to demonstrate that we've got adequate funds available to complete the decommissioning job.

In the UK, the Nuclear Installations Act, which is what fundamentally governs all of nuclear power legislation says that the license can only be revoked when there has ceased to be any danger from any ionizing radiation from anything on the site. Now you will recognize that that is truly impacticable -- probably impossible. The government lawyers in 1964 who framed it clearly didn't know very much about natural radioactivity.

Clearly it's very different from the position that you've got here in the U.S. I'm always somewhat amused to come over here and hear you arguing about, the NRC wants 25 millirems and the EPA wants 15 millirems. I expect that the way we should finish up here is pragmatically interpreting the European Community Basic Safety Standard, which will mean that we shall probably delicense our sites at 1 millirem per year, using some form of pathway analysis.

So, our company's vision for decommissioning is that the reactors will be dismantled, the sites will be delicensed, the resultant waste will be disposed in accordance with government policy, which would be to a deep geological disposal site eventually. I think crucially that decommissioning strategies and their implementation methods

-- and that needs underlining -- will minimize the risk to the public to our workforce and the environment.

We also will do decommissioning at a minimum lifetime cost, consistent with world-class safety. But I want to emphasize that this vision doesn't foreclose any other options. If future generations want to revert to *in situ* decommissioning, they can if they so choose to and that of course will avoid the dismantling dose and cost.

The licensee's strategy for decommissioning in the UK, then, the publicly declared strategy, both by ourselves and by British Energy, is that safety, waste minimization, and disposal site availability, together with cost considerations, lead us to a strategy of safestore, with final dismantling being deferred for a period of up to -- and again, I emphasize "up to" -- 135 years.

What do we actually mean by safestore? Well, the first thing we'll do is reclad in high-durability materials, recognizing that our buildings are not containment structures in the same way that yours are in the U.S. The buildings will then be weather-proofs to make for minimum degradation of internal systems. And we're currently doing a huge amount of measurement work on the reactors that we have shut down. We actually have six reactors shut down at the moment, permanently, in a state of decommissioning. And we've measured steel corrosion rates on all this plant in a whole variety of circumstances and we find that's just a few microns per year.

We shall ensure that the safestore design makes the building intruder-proof -- and that's intruder-proof for

forced entry as well as inadvertent intrusion. However, we don't propose to have any permanent manned security, but we will have routine inspection, monitoring, and where necessary, maintenance.

The next picture shows one of our shutdown sites, just to give you a little bit of orientation as to what these plants look like. This is Trawsfynydd in North Wales, a two-unit plant, as you can see, with the two reactors there. And the next picture is an artist's impression of what we think the safestore will look like. You can see at the top the site as it currently looks at the moment, looking down the approach road and down the bottom there, the reactor buildings have been covered in this rather curvy, architecturally supposedly wonderful building. I leave it to your judgment as to whether you think it's that architecturally wonderful.

Now, we're not of course going to walk away from these plants. Our inspection and monitoring proposals are that we'll have continuous but remote monitoring of security, fire, water -- as water ingress into the sumps -- temperature, humidity. We expect this remote monitoring to be at one central site in the UK, probably one central site that covers both the licensees looking after the monitoring of, say, forty reactors. And that site, of course, will be manned continuously, with probably a four-hour response time for local police to get to the site in the event of a security breach.

There'll be a weekly internal inspection of the safestore structures, and inspections inside the buildings

every six to twelve months. Every ten to twenty years, we plan to do a structural survey, and we'll also do a structural survey after abnormal events like a significant earthquake or very high winds.

We propose to maintain our environmental monitoring -- that's the radioactive monitoring. But we assume that we'll be able to reduce the frequency as confidence grows over the years.

Now, everything depends on the safety management system. In the UK, BNFL will continue to hold the site licenses, as it does at the moment. It will therefore have legal responsibilities, which it will be obligated to carry out, which will include routine inspection, monitoring and maintenance, routine review of the safety case and the strategy that's enshrined within the Nuclear Installations Act and the license conditions.

We will also fairly crucially, I think, have to maintain the competence across the company, and this is something else which is also in our license conditions. And that I think is a very important issue. When you're looking at whether to defer dismantling, where are you going to get the competence from? Is it worth keeping all this competence? Within the UK, where we shall have forty units shut down and only two licensees, and potentially only one company looking after the whole lot, we can readily maintain the competence.

If you look at some of the plants in the U.S. that have been shut down and totally dismantled, I think they tend to be owned by companies with just one reactor, where

it clearly wouldn't be cost-effective to keep the necessary level of competence for a long period.

We also need to keep adequate funds to complete the decommissioning process. And we assume that the Nuclear Installations Inspectorate -- that's the British equivalent of our friends in the NRC -- we assume that they are still going to be there, that they will continue to monitor us and impose corrective actions if necessary.

So moving on to the safestore safety case, I think an important issue here to remember is that over the history of nuclear power, dose targets have come down very significantly. Our company dose targets have come down by about a factor of ten in the last thirty years, and within the UK, the legal limit has fallen by about a factor of a hundred in the last fifty years. We therefore propose that the safety case acceptance criteria that we use to build our deferred safety cases will be ten percent of current levels, which means that the annual dose limit for normal operations of the deferred safestore structure will be five millirem for the public and 150 millirem for the workers.

We've completed a major safety case for safestore, particularly for Trawsfynydd, which we anticipate to be the first plant to go into safestore. This safety case would essentially be the same case as we would make for any period before *in situ* disposal or entombment, if we were to go this way. So we've done a very systematic and comprehensive hazards schedule, which includes potential hazards from things which we haven't got at the moment, but which we can foresee -- issues like global warming will clearly create

additional hazards into the future, which we perhaps can't quite quantify.

We've done hazard analyses for all of the hazards on the hazard schedule, and you can see what the highest dose is to members of the public. A complete failure of the care and maintenance system would give about 300 millirems. That would assume that we just walked away on day one and that we did nothing, and that the Government body, the NII, set up there to monitor us, also went away and did nothing.

Aircraft crash and a subsequent fire gives us 1,600 millirems. That's the largest hazard we could find. Fault frequency there is very small, with a probability of an aircraft on Trawsfynydd is 5(10^-8) per year. Nonetheless, if it should happen the subsequent fire would give quite a high dose. Intrusion, we think, is only about six millirems because of the layout of the plant inside the building, essentially. And the total risk to members of the public from all faults is less than 3(10^-9) per year.

It may be just worth mentioning that the normal operations dose from the, from the safestore -- I mean, we use the term "operations", and that just means the normal dose when the thing works as we anticipate it will -- actually comes from the dog-walking scenario. And that comes to be about not 0.3 millirems per year -- essentially, people walking their dogs on the sites, because we have no security in our plans. therefore, we would take the site boundary fence away, the security fences would go, people would be able to walk their dogs up around the outer boundary of the building if they really wanted to.

So what are the benefits of safestore? Well, it allows us systematically and progressively to reduce the hazards by natural radioactive decay. I think very importantly, it also reduces the consequences of faults during dismantling. This tends to be something which people forget. They only really consider the doses to the decommissioning workforce. But of course, using robotics and shielding, if you're willing to spend enough money, you can get that dose down very low. What you can never actually do is totally eliminate all the faults during dismantling. And remember, of course, we have graphite cores, which in principle have the potential to be able to catch fire during cutting operations. So reducing the consequences from faults is quite important to us.

We shall also reduce the volumes of waste for disposal -- much simpler technology for dismantling because we can get personnel into our reactors vessels for useful periods after about 85 years. And of course, you've also got much lower lifetime costs.

You can see here the variation of the gamma dose rate inside a magnox reactor. This is the dose rate at the most active part of the reactor. And you'll see that this dose rate falls by about one million-fold between the time from shutdown down to about a hundred years and there's no further reduction after about 135 years. You have to remember that -- if you, if you could just leave that one a moment please, Carl. If you could just also remember that magnox reactors are primarily carbon steel. There's very little stainless steel in a magnox reactor; therefore,

there's not the high cobalt levels that you're used to seeing. Neither is there the high nickel levels which give the nickel 59 bremstrallen and we don't have very much niobium-stabilized steel.

The important thing here is that man-access is possible the whole working year after about ninety years' decay, where you can see that the dose rate is only about one or maybe not 0.3 millirems per hour. Okay. Next one, please.

So what are the consequences as we've calculated them, of dismantling deferral. And here, I need to be very careful because I've done all sorts of conversions from pounds to dollars and let's make sure I've done this right. Over the time-scale of interest, relative to immediate dismantling, we think we can reduce worker doses by about 75 percent. Now this, remember, is for deferral of dismantling. So in the end, we actually do take the plant apart.

We'll reduce the number of waste package shipments by about 98 percent, which is clearly very important because when you think of the risks from road transports, that's about 10^-4 per year in the UK -- somewhat higher here, about 10^-3 per year in the U.S., I believe. So if you can reduce the number of waste shipments, that's actually quite important.

The discounted costs reduces by around 80 percent. And we need to be a bit careful with this because in the UK, we discount it 2-1/2 percent, which is higher I think that you would have in the U.S. Of that discounted cost,

something like forty percent comes from easier engineering and less waste disposal, and about forty percents comes from the effect of discounting. So by deferring for this period of time, we safety about forty percent of the total cost.

Now, totaled over all of the UK's reactors, that comes to about $10 billion. So as we said this morning, forty percent of a large number comes to a very large number, and multiplied by a significant number of reactors, comes to an even bigger number, if you follow what I mean.

If we look at *in situ* disposal, that saves about 75 percent of the cost without discounting. I haven't actually got that on the slide, but *in situ* disposal we think saves about 75 percent of the cash cost, and about 80 percent of the dose. And that's including the institutional control costs.

We calculate, totaled over the full institutional control period. And in the UK we'd have a 300-year institutional control. We'd calculate that the costs are about three percent of the immediate dismantling costs.

So in summary, in the UK we've got no waste disposal facility. Our reactors are large, and so they must be dismantled onsite. And I think crucially, no disposal facility cause no choice. Here in the U.S. at the moment, you've got a choice, but in the UK we haven't.

Our safety case shows a vanishingly small total risk from safestore. I haven't actually got the numbers with me, but it's also a very small risk from *in situ* disposal as well. However, our safety management system must remain in place. We get significant savings in dose,

waste shipments, and cost. But I think it's important just to emphasize again that our declared strategy doesn't foreclose the option of turning deferred dismantling into *in situ* disposal, or entombment. And whether or not we dismantle or we *in situ* dispose on the site, we believe that institutional control can and will be effective.

The defense and depth provided by the concrete shields and the steel pressure vessel gives huge, hugely adequate engineered protection. Financial provisions which are required and very much lower -- than you may get dismantling and fundamentally we believe it's much safer to defer than to dismantle immediately. Thank you.

If there's any questions, I'll try to answer them.

BYRNE: Dr. Woollam, Jim Byrne, GPU. Does Great Britain have clearance limits for solid radioactive material?

WOOLLAM: Yeah. Solid radioactive material clearance limits are not 0.4 baccarals per gram.

BYRNE: Does that play into your decommissioning decision? Because there's no such, nothing similar thing in the United States. I guess the NRC's working on them now.

WOOLLAM: Yeah. You haven't actually got that over here. But we have a clearance limit of not 0.4 baccarals to gram, which I can't convert to curies in my head, but I'm sure somebody can. That's totaled over all isotopes. Paul?

GENOA: Yes. Paul Genoa, NEI. Thank you for that good overview. One question was on the, on the risk from the aircraft accident and the fire. Was that assuming

that the graphite core actually caught fire? Is that the worst-case scenario?

WOOLLAM: Yeah, we do assume as a worst-case scenario that the graphite core will catch fire. Unfortunately, if you do the thermodynamics, it's very difficult to demonstrate that it will. This assumes a fully laden 747, which had just taken off from Heathrow heading over here somewhere; 130 tons of fuel; lands on the reactor. All the fuel conveniently pours down inside the bioshields and catches fire. It's not obvious that the graphite will catch fire. My people tell me it won't, but we don't quite have the nerve to say that it won't.

Any further questions?

[No Response.]

TROTTIER: Thank you very much, Paul. What I'm going to ask now -- if the panel members for our afternoon panel would come up here, and then I'll go through the issues in the Federal Register notice. So we'll take about a five-minute break while we assemble up on the podium. Thank you.

[Discussion off the record.]

TROTTIER: Okay, I think we'll go ahead and get started. But the panel's assembled, so I'd like to progress.

What I thought I would do is walk through the issues that are in the Federal Register notice, you know, just to mentioned them. Most of you have, probably have seen copies of the Federal Register notice, so you're aware of them. And then I'm gonna turn it over to Carl Feldman

who's gonna moderate the panel. And he'll introduce all the panel members. And what we're gonna try to do this afternoon is discuss each one of the issues that are in the Federal Register notice.

I want to remind you, again our reason for holding this workshop is, we need to gather information. And so we thought that it would be beneficial to have a panel kind of talk about the issues as a way of triggering questions or thoughts in your mind that might help us focus on this issue a little better. And when we, we drafted this Federal Register notice, what the Staff really had in front of it prior to that time was the work that PNNL did, so we really want to get beyond that to the next step. What other information do we need? So really, as you're looking, or listening to comments, think about what other information is pertinent to making a recommendation to the Commission.

With that, I'll quickly read through these issues and then Carl will take the panel through issue by issue. And as you might guess, because there are a lot of issues, that is the primary reason we said it may take more than today to get through them. In other words, that is the reason we would continue tomorrow if we needed to.

Okay, so with that, I will most through the list. And the first question that we raised was, how meaningful are the assumptions in the PNNL report that institutional controls will be effective? That is an assumption given in that report.

Second issue: Does the PNNL analysis rely too much on long-term engineering features that would be needed

for entombment? What criteria would be used for approving a licensee's request for using the entombment option, and what quantitative values could be examined for establishing the high degree of contaminant isolation confidence that would be considered acceptable.

Third issue -- what financial provisions would be required to pay for the future expenses that could be expected during the lifetime when restrictions for the entombment must be maintained?

Fourth issue -- how significant would the entombment option be on state resources if it were implemented?

Fifth issue -- if new legislation were required for disposing of the greater-than-Class-C waste through the entombment option, is it worth pursuing? Is the current legislation consistent with what has been implemented by the NRC for low-level waste disposal of greater-than-Class-C waste for specific circumstances, including consideration of eventual license termination? What is the role of DOE with respect to greater-than-Class-C waste considerations? Now I will mention that I think that issue is not gonna be discussed this afternoon, right Carl? That's for tomorrow's panel.

Issue number six -- is entombment consistent with the Low-Level Waste Policy Act, which encourages centralized disposal and the encouragement of regional compacts, as well as economic incentives through exclusivity by only permitting disposal of low-level waste in Part 61 licensed facility?

And issue seven -- what is the option of the states on the entombment option? Is the possibility of ultimate or long-term management by the state a concern?

And the last issue -- is there any indication of the number of licensees intending to use the entombment option? Which I believe is a question that was raised this morning by John Greeves.

And with that, I'm gonna turn the panel over to Carl Feldman.

FELDMAN: Thank you. I thought we would split this issue, set of topics into a few topics into a few parts. And the first part I thought would deal with technical and regulatory issues. And with that in mind, I thought issues one, two, three -- I'm sorry. One, two, three, partial, because it could be other issues as well. And issue eight would be the ones we would try to get through today. And then tomorrow whatever remains of three that we that we think we still want to discuss, and issue four and issue seven. There's also a DOE panelist issue session tomorrow morning, and that I think would deal more with issues five and six. So we won't discuss those issues with this panel.

I think I'm gonna take the easy way out in introducing the panel by letting them spend a few minutes, each one, introducing themselves and just saying what their interest in the entombment option is. Paul, would you go first?

GENOA: Yes, good afternoon. Paul Genoa, representing the Nuclear Energy Institute. We are the

policy, Washington-based policy organization of the nuclear industry. We represent about 220 members in 20 nations worldwide that use nuclear technologies to provide important benefits day to day.

FELDMAN: Amy?

SHOLLENBERGER: I'm Amy Shollenberger. I'm a senior policy analyst for Public Citizens Critical Mass Energy Project. We're a public health and interest group based in Washington, DC, founded by Ralph Nadar. And we have approximately 150,000 across the United States.

FELDMAN: Bill?

SHERMAN: I'm Bill Sherman. I'm the state nuclear engineer for the State of Vermont. I work in the Vermont Department of Public Service. We're involved in both safety regulation and also economic regulation of nuclear energy in Vermont, so we have both of those interests.

I'll speak about one state's interest. I know that there's some other state folks here. I know that Connecticut, Florida, Illinois and New Hampshire -- maybe others. But, and so I hope that to the extent that I express one state's interests, my other fellow, other common state people will come and, and correct things. Thanks.

FELDMAN: Jack?

PARROTT: I'm Jack Parrott of NRC staff, and I've worked for ten years in the Division of Waste Management, working on decommissioning issues for both materials and reactor facilities, and also a little bit with DOE issues, low-level waste and high-level waste.

FELDMAN: What I thought I would try is, I'll

read the question, let anyone on the panel address it, and then we'll just turn it over to the audience and let them have their comments. And then we'll go on to the next issue.

So I'll read the first issue. And it's, how meaningful are the assumptions in the PNL report that institutional controls will be effective? Anybody on the panel want to say something about that? Paul?

GENOA: Paul Genoa, NEI. I think it is important to recognize that the country has significant experience in applying institutional controls for a variety of risk-based corrective actions. In fact, I'll be happy to provide it afterwards, but the EPA has a website address that defines a range of these institutional controls and their history.

They report that institutional controls have been used extensively throughout the United States and that Federal, state, and local laws and codes have required various institutional control mechanisms for conservation area protection, aquifer protection, historical protection, development limitations, hazardous and solid waste facility closure, notice of contaminated sites, notice of burrowed utilities, etc.

When institutional controls are used, a control notice or requirement or notice is recorded with the appropriate regulatory agencies where reasonable, diligent inquiry would uncover the existence of such a notice. Examples of different types of institutional controls are: structure use restrictions, land use restrictions, natural resource use restrictions, well restriction areas, deed

restriction, deed notices, declaration of environmental restrictions, access controls, monitoring requirements, site posting requirements, restricted covenances, and Federal, state, county, local registries and zoning, are examples.

FELDMAN: Thank you. Anyone else care to comment on it? Amy?

SHOLLENBERGER: Well, first I think I would like to say that the question should go back a step as far as whether institutional controls will be effective because I think it's important to ask whether they're acceptable as they are. And so one thing I would just like to say from the very beginning is that we think, a public citizen, that the institutional controls should include a zero, zero release standard. So that's number one.

And I think number two, asking whether the controls would be effective should really address the question of this greater reliance on engineered barriers, which we're going to get into a little later, so I won't go into it too much now.

FELDMAN: Yes.

SHOLLENBERGER: But I think it will take a lot of work, on the part of the NRC especially, to ensure public confidence that you all are going to be able to make sure that those barriers are gonna be effective.

SHERMAN: Agreeing with Amy, I think that we should go back a step with the question. And I'd like to at least give a flavor of what we feel about the issue in general in the State of Vermont.

Our basic feeling is that it makes little sense to

remove, for millions of dollars, the radioactive waste on the site that's not very dangerous, and then to leave the spent nuclear fuel, which is really dangerous, on the site for long, long periods of time.

And so our basic -- and we look at some of our colleague states in New England that are spending that money now, and Vermont wonders -- I guess, Carl, what this means from our point of view is that, and some specific answers to John's question this morning, is that I note that our international speaker, in his presentation, first covered what happened to spent fuel. But I note that in none of the, none of the presentations that were made by our domestic counterparts was spent fuel mentioned. And that's a problem with your policy. That's a problem with the way that you are structured, such that, that spent fuel is somebody else's problem.

And that's a problem because when we sit in the states -- again, I'll restate my thesis. It doesn't make sense to spend all this time and millions of dollars and leave the really dangerous stuff sitting in our states.

Your problem is compounded by, by this thing right here, which is this waste confidence policy that, that I think was published this last week, which you have to put up the front that spent fuel is gonna move sometime soon. And what that creates is bad policy. So, for starts, and then I'll stop talking -- but you're gonna hear this mantra over and over again from this point of view.

For starts, it's a reasonable thing to, as long as the spent fuel is on-site, to have a primary option of not

dismantling the rest of the plant. This makes a tremendous amount of difference money-wise. And let me take one more minute to say something about money.

Right now, the nuclear plant in Vermont estimates the cost of decommissioning to be about $500 million in current dollars, $400- to $500 million, and has about $200 million put away. If we do nothing and just invest this $200 million in the next, in fifteen years, at the rate at which the fund can earn, it will have about the money necessary to do decommissioning. It might be some millions short. But if you left that plant set with that nestegg there until the spent fuel is scheduled to be removed, which is in the year 2030 or 2031 -- and that's at the 2010 estimated date of tank fuel -- there's $300 million surplus. If spent fuel gets pushed ten years out, can you believe it? There's a billion-dollar surplus of that nestegg. Well that's real money.

So again, I think I've made that point. Thank you.

FELDMAN: Thank you. What I'm gonna do now is throw it open to the audience for comment and then I'll go on to the next question. Does anybody have any comments on this particular issue?

[No Response.]

FELDMAN: Okay. Let's go onto the next one. The next issue is, does the PNNL analysis rely too much on long-term engineering features that would be needed for entombment? What criteria would be used for approving a licensee's request for using the entombment option, and what

quantitative values could be examined for establishing the high degree of contamination isolation confidence that would be considered acceptable?

Anybody on the panel want to try that one?

GENOA: Well, you know you're gonna get me.

FELDMAN: Yes, I know that.

GENOA: Paul Genoa, NEI. It's a two-part question, and I think it's appropriate. It's easy to look at an operating power plant that's been in a community for 20, 30, 40 years before decommissioning to recognize that the engineered barriers have been adequate to protect the public from the operation of that facility, power operation, all the maintenance operations, all the different refueling activities, that all that material's been contained, and then in a decommissioning mode to remove the vast quantity of that material in the form of fuel and greater-than-Class-C components. You've essentially removed 99.9 percent of the activity of the facility.

However, all the barriers are still in place. So it's easy to imagine that those barriers would be adequate to continue protecting the public for a long period of time. And I think that although the PNNL study is not exhaustive, I think it points to various other studies that have been done to show that these structures are as sound as anything made on earth today, that they are very protective, that the -- as we've learned from our British colleague -- that the corrosion within an entombed structure is very, very slow, microns per year. When you're talking about reactor vessels that are six- and eight inches thick, that's a long time.

The containment structures themselves, the base mat is ten feet thick. The walls are three to four feet thick. These are massive structures that aren't going anywhere in the near future.

But the second part of your question -- and so I believe that we can rely on engineered structures and I believe there's a wealth of engineering, civil engineering knowledge to back that up, and national and international experience.

But the second point is, what would the right criteria be? And I believe that essentially that criteria already exists in the license termination rule. The dose criteria for the entombment option should in fact be the same criteria and the same protection afforded the public under 10 C.F.R. 2014, the 25 millirem per year dose standard plus ALARA, assuming the institutional controls are maintained. And then perhaps the exact same criteria, if in fact they were to fail, would be assumed at 100 millirem per year.

FELDMAN: Thank you. Amy?

SHOLLENBERGER: Well, as I said earlier, I think that the increased reliance on the engineered barriers is something that, that we would like the NRC to take a really close look at. I think, in reading this paper, the increased reliance on engineered barriers, coupled with the paper stating that under an entombment scenario the most likely source of exposure would be inadvertent slow leakage of contaminants from the structure. And with these waste -- what will be waste sites located a lot closer to the water

table than is usually permitted for a waste site, because of the location of reactors near water, for the most part, because the water's needed for their, for their running. It seems that you would need to really increase the criteria needed to approve the licensee's request instead of keeping it as it is now.

And also, I think the, the allowing of the higher, the 100 millirem per year exposure rate is just absolutely unacceptable, especially when it's not really clear to me that anyone really knows how the exposure will happen from the entombment scenario. There's this slow leakage possibility, and it seems to me that if it's going to leak into the water somehow. And so the pathway is, is most likely going to be water, but it could also going to be food and that sort of thing. And so it seems that stricter controls would be appropriate rather than the same or looser controls.

SHERMAN: And Carl, as I mentioned, I apologized for not answering the questions in the mode that you'd probably like.

From what I mentioned before, what, what seems to us important is for you to roll in the spent fuel possibility into this, this question and issues. And what we're facing in the states, especially with the proposed Department of Energy taking title to nuclear fuel on our sites, we are facing the possible, the possibility that Nevada will not work out and the possibility that spent fuel will be on the sites for a very long time.

We believe that in common with the considerations

for decommissioning, you must review the engineered, the reliance on engineered barriers for spent fuel, and common this up. And in that way -- not to have a double standard, but to have a common standard for the waste that's not very dangerous and the waste that's more dangerous.

FELDMAN: Thank you. I haven't called on Jack because he's gonna be a resource and information person, but if you have any comments, Jack, feel free to make them.

SPEAKER ["P]: Thanks, Carl. I, I guess I would just say, maybe in an effort just to stimulate more discussion from the audience, in our license termination rule on Part 20, the assumption there is, as far as institutional controls go is that you can factor those into your analysis, but you can't rely on them after the license is terminated. So that -- to what extent, I guess, would that need to be changed to accommodate this entombment option? And is it reasonable, do you think? I think that the write-up by Steve Short relied on a lot of DOE examples, but, where they might have a different philosophy towards that, and I'd like to hear, you know, some other viewpoints.

FELDMAN: Okay, you have a comment on question 2?

GUNTER: Not directly to the previous questions. But -- Paul Gunter, Nuclear Information Resource Service.

You know, one of the problems that we see, and I think it's not gonna be a popular opinion here in the context of this meeting, but is that we continue that we approach these problems in their dissected form and we never look at the whole picture.

And just quickly to respond to, you know, Mr.

Sherman's unique responses to the issue here, it's not too late for us to reassess cutting our losses, so to speak, in terms of this fuel conundrum, by the cessation of production. And that's our organization's position, so I would just like to put that on the record, that, that that is one of the options that we can factor in, in addressing the long-term issue here.

But more particularly, in terms of the question number 2, we don't share the same levels of confidence that NEI does with regard to the current structures. In fact, we agree with Public Citizen that the standard should be made more robust. And particularly, there are cases in point where we're seeing the erosion of concrete, the cracking of building structures, that are cases in point with regard to, you know, the existing structures.

FELDMAN: Okay. Anyone else? Yes.

FRICK: John Frick, ASCENG. I'd just like to say, as an industry we do have a lot of experience in looking at mothballed, or entombed, structures. CVTR, for instance, was opened just this year for dismantling. Hayward Shew was a good friend of mine who worked at the plant when it was operated, and was the head of the Radiological Division for the State of South Carolina. When he walked in, he told me it looked like a time capsule. The plant looked exactly -- the paint, the structures, even the tool boxes the employees used, were still there in the same place; it looked exactly the same as the day that it had been closed.

What we know is that, as far as engineered features, is that we have multiple barriers that exist in

every plant to prevent the release of radioactivity. For instance, most of the radionuclides are in the form of oxides on the inside of very thick stainless steel and carbon steel pressure vessels and piping. It's very difficult for that to get outside of the piping systems. Those piping systems are then contained within very massive civil structures that we know are very resistant to erosion and decay.

There're structures that have existed for hundreds of years that we know of that were put in place in very similar types of construction techniques, from stone to concrete. So when you look at this, really the problems with engineered barriers are not insurmountable. And in fact are better, in most cases, than just relying upon geological, you know, constraints which may or may not always be uniform.

So that's -- I just wanted to say that, again, the entombment -- in fact, I would go ahead and say, if you look at the, what we consider the best-case approach for dismantling a reactor, is you rely upon the barriers for fifty, sixty years. Reactor vessel then goes from hundreds of thousands of R to maybe 2 R an hour. You then dismantle, take out after a safestore period, you take out the greater-than-Class-C waste. Then you're really relying upon the remaining civil structures for maybe a total of a hundred years.

Everybody wants to remove the Class A waste; Class A waste is not a problem. The stuff that's the real problem is the thing that the Government has taken, for instance

from our company, a single-unit site, over $80 million to dispose of, and still we got nothing for the money. So the real issue is -- and what we consider the best approach -- is delay the safestore units for some period of time, 30 to 60 years, then take out the greater-than-Class-C waste. Button up everything else, and it's really not a technological problem.

FELDMAN: Thank you.

SHOLLENBERGER: I think, first of all, I would like to support Paul's statement that there is still time to stop the madness, as it were. And Public Citizen is on the same page with, in that policy, where we think the number one answer is to stop producing the waste. So I just wanted to get that on the record for us as well.

But I also would like to speak to the engineered barriers debate. And I think that as Paul said, Paul -- is it Genoa?

GENOA: Yes.

SHOLLENBERGER: -- said, and also the person that just spoke said, it's true that the barriers are some of the strongest structures made in the world. I'll admit that. But I think it's also really important to note that water is one of the most persistent elements on the planet. If I learned correctly in my geology class, the Grand Canyon was made with water.

And from my experience sitting in meetings of the ACNW and other meetings here at the NRC, one of the biggest fears is, for any waste site, is that water will penetrate. It's one of the biggest debates on Yucca Mountain right now.

And I'm just looking at the paper here on page 6. One of the things that the papers opens up for discussion is that it says that the criteria for siting a nuclear power plant is inherently different than that for a low-level disposal site. Specifically, requirements precluding low-level waste disposal and a 100-year flood plain, coastal high-hazard or wetlands, or in the zone of fluctuation of the water table are not necessarily compatible with existing reactor site characteristics.

Thus, special exceptions to existing 10 C.F.R 61 requirements would be necessary to permit dealing with an entombed reactor under 10 C.F.R 61 following final closure. I think that's a really important point. It's, it's kind of put in here nonchalantly, and I think that the people who have such high confidence in the engineered barriers might not want to discuss that, but I think that it's something that needs to be in the forefront of any discussion, that you have to deal with the water.

FELDMAN: Just a point of reference. Earlier, we had some discussion about what was in the PNNL report, and there was some confusion as to when the greater-than-Class-C material was removed. Would you want to speak to that, Steve, for a minute?

SHORT: We talked about this at lunch, and Dick was right; I, I was wrong. We did assume that the GTC stuff was removed right up front in the analysis. The other point, though, to make is that in the, in our studies, we always assumed that GTC was cut up underneath water and so it really didn't incur a whole significant lot of dose from

the operation. And so even if you removed it later, you don't save a significant amount of dose over what we've shown in that table. So, anyway. . .

FELDMAN: Any other comments on Issue 2?

WILDS: Ed Wilds from Connecticut. I guess our biggest question on relying on the engineering barriers is going back and determining if this should be allowed for all low-level waste disposal facilities, to require a low-level waste disposal facility to go through the Part 61 analysis. And to allow entombment seems a little strange to us. And there are still questions on whether the Commission would allow assured isolation, which may be a very similar option.

And when we talk about it, our biggest question is, if it's allowed, if entombment is allowed at a power reactor facility, what is the sense or the reasoning behind not allowing a similar facility structure to be built across the river and not licensing it for low-level waste disposal?

So I think, for us you've got to go back to the question: Should engineering barriers be allowed in the disposal of low-level waste to begin with?

FELDMAN: Yes, Paul?

WOOLLAM: Paul Woollam, British Nuclear Fuels. Perhaps I could just ask if anybody has thought to extend this debate beyond engineered barriers for nuclear power? It's a fact of life that we all use electricity. Nobody, I think, wants to go back to the days when we didn't. The question is, how do you deal with the aftermath of the power generation system? We're concentrating here on the entombment of nuclear power reactors.

I think also we need to consider, how is the waste managed from other forms of power generation? I'm not sure, quite, how you do it in the U.S., but in the UK all the fly-ash from coal-fired power stations gets tipped into large lagoons. It has a high level of transition metal, heavy metal content -- in fact it's more radioactive than a lot of the stuff that we send off to our low-level waste disposal sites.

I think you have to be very careful here that you're actually producing a level playing field across the whole pace. It's no good saying, yes, you know, we wish we'd never had nuclear power. You have to deal with what you've got, and you have to deal with it in comparison to other sources of power generation. If you calculate the risk from entombment, you'll find that it is of the order of 10^-7, 10^-8 per year.

Now I know that people don't like talking about risk, but it is a fact of life. Risks are a fact of life. You have to deal with the risks from everything. I just wonder if anybody's actually calculated the risk from the closure of coal-fired power stations.

And while we're on the same sort of topic, if you get rid of all the nuclear power stations and you replace them, as we are in the UK, with gas, then again, all you're doing with CCGT is putting more and more carbon dioxide into the environment, and you're risk all of the global warming issues. Now what are the risks to all those people, all the people who live in Bangladesh, rising sea levels? We really have to get all this in a level playing field.

FELDMAN: Thank you. Paul?

GENOA: Paul Genoa, NEI. An impartial response, Paul. In the United States, fly-ash is allowed to be mixed as an additive to concrete. And in fact, the EPA allows that to be added up to a level that would include about 10 millirem exposure per year to an individual, assuming a residence scenario. And in fact, the Federal Government requires the use of that fly-ash in concrete for all Federal work projects, Federal contracts. So that's one way we deal with the coal ash.

The issue of alternate -- or of "stopping the madness," so to speak, what we have to recognize, as you've pointed out, that you need to replace the electricity with another form, currently to replace the existing capacity of the nuclear facilities in this country, all we need to do is turn off our lights for about five hours a day. And I guess if we're all willing to do that, you know, that's an approach.

One final comment on engineered barriers, and Amy's concern -- and it's absolutely accurate. Water is the universal solvent. And water will get into things eventually. But time is on our side in the issue of radioactive material because there is natural decay and it is, it cannot be changed through physical processes. And so, although the Grand Canyon was dug, it was done so over eons and millennia. And the type of material that we're talking about here, of any quantity, is going to be gone in a few hundred years, and that's what's important to stay focused on.

FELDMAN: Thank you.

SHAFFNER: This Jim Schaffner, U.S. Ecology. A number of years ago, of course, NRC promulgated a regulation for the disposal of low-level waste, Part 61, which placed a heavy reliance on the geologic considerations -- making sure that the site itself had the kind of inherent characteristics that would provide for long-term isolation. In a lot of ways, what is being considered here seems to be -- and I think it's been acknowledged in the PNNL study -- sort of diametrically opposed to the concepts of Part 61.

Given that my company and a number of other companies have already gone through the process of selecting and characterizing good sites through the Part 61 process, but ultimately these sites didn't go forward, not for technical reasons but for political reasons, is there any reason to think that the end result wouldn't be the same here?

SPEAKER [P]: I'll take a shot at that. I guess the only, the -- of course one of the real differences is that the waste is already at these sites, so that gives them a leg up, I would say, on being able to do this. You don't have to move it anywhere; you don't have to get another site. Even though, like you say, there are, there undoubtedly would be better sites to put this stuff. But, you know, the waste is there.

SHAFFNER: I just -- obviously, it's a tough question to answer. I just wanted to sort of get it in the mix.

SHERMAN: And -- Bill Sherman from Vermont. From

a state perspective, we really are colored by this mantra that I'm saying today. You know, looking at the possibility of spent fuel being there, we, why shouldn't we leave the reactor there on that site? Looking at the, looking at the fact that the spent fuel is in engineered barriers, why should we be so concerned about the low-level engineered barriers?

Looking at the fact that, as Amy mentioned, the non-compatibility for waste disposal, but the spent fuel being there, why should we not be -- you know, why should we so concerned about the low-level? I really do believe that we have to re-orient and think about the spent fuel first, and not partition these things.

SHAFFNER: But that seems to be the process that started back in the '70s when the Nuclear Regulatory Commission put its emphasis on the high-level waste back in the late '70s and early '80s. At that point, the low-level waste issue was solved. Now, in the last two decades we've essentially un-solved the low-level waste issue, and we're back looking for another answer for a subset -- not for the complete subset, not for the completely universal low-level waste, but a subset of low-level waste.

SPEAKER [P]: Jim, let me ask you a question.

SHAFFNER: Sure.

SPEAKER [P]: If, under this entombment, I guess there's a couple of different ways to go. I guess you could look at it under a Part 20 license termination rule and what that requires, and also under Part 61, which is a much more prescriptive type of regulation. And to pick up on

something that Dr. Wild said, from Connecticut, to what extent should entombment be allowed to do things that you can't do under Part 61, and do you feel that that creates a conflict?

SHAFFNER: Well, I don't know that I could offer a very complete answer for that right now. I guess, again, I'm looking at where we've been in this issue for the last 20 years. And NRC has designed a perfectly, what I considered a perfectly rational, reasonable long-term solution. And we were all about working toward that solution for the last 15 years or so. And essentially, at the end of the day, as John Greeves mentioned this morning, we didn't get there.

And now it seems as though we're taking a step back and saying, okay, we've got to regroup and, you know, and try something else. And obviously you're at a point -- you're, it's sort of an unfair comparison because you really haven't had, had the rulemaking and all the guidance development for this. You know, you're at the embryonic stages as opposed to the Part 61 process. But it, it just strikes me as sort of a significant step backward.

FELDMAN: Paul?

GENOA: Paul Genoa, NEI. One last thought on that, Jack -- and perhaps Paul, my international colleague, can help me if I get into trouble here. But I believe that the ICRP, as adopted by the IAEA, their approaches differentiate between a practice and an intervention. And the siting of a new low-level waste disposal facility would essentially would be a practice -- it'd be prospective.

You'd be looking forward and you'd be designing it the way you'd like to.

In the event that entombment was made available as an option, perhaps in a contingency mode because disposal wasn't, you could really view it as an intervention. You have a certain amount of risk at the facility; you're gonna try to remove that risk. How are you going to do so? You're going to take the following steps to isolate it from the environment. And so perhaps there is a different way to look at it. I'm not sure if it's clearly falls into those two categories, but that's sort of one way to deal with it, to look at it.

HELMINSKI: Since we've gotten to general policy issues -- Ed Helminski from the Radioactive Exchange. I'd like to raise this issue generically in a different way, and let's disconnect it again from high-level waste. But I think what is more interesting is that we are, had rubblization activity in a workshop; we've had one on entombment. And we're also struggling with assured storage facility. Put some perspective on entombment.

If you went to Texas and just looked at what happened in the last week, you'll find that what they were proposing was an off-site entombment facility. Yet NRC is looking at entombment as another option when it is nothing other than the way the states are looking, at least some states, at assured long-term isolation facility. Just if you don't know, Texas is proposing -- a company is proposing to the state -- an assured storage facility to be licensed for storage for five hundred and some odd years. Now, in my

view, practically as an engineer, that's disposal.

Now the Canadians did have an answer to all of this. They called disposal "storage," and I guess that's what we're trying to do with entombment. The Chalk River facility in Canada is a shallow-land burial facility. But it's not called, in Canada, a shallow-land burial facility; it's called a storage facility because they're gonna go back and get the waste out. I don't know when they're gonna do that, but that's what they say.

I don't think we should proceed along this alphabet soup here at the Commission. It would be, I think, for the Commission to face the issue of long-term storage the way it's being presented institutionally by various aspects -- the industry, entombment and rubblization; the states, assured isolation, which is structurally and engineering-wise -- we're not talking a lot of difference. We're talking about building an assured storage facility that's gonna last for 500 years. We're talking about entombment using an engineered facility, namely the reactor containment building, to store waste for a number of years.

In rubblization, we're talking about using the engineering that went into the foundation and dumping inside. It's still on-site disposal. And they're all related. And the debate and looking at all these differently doesn't make any good sense in a regulatory framework right now. Because what could very well happen is you're gonna come up with conflicting regulations for an assured storage facility that's supposed to last for 500 years, for an entombment facility that's gonna last for a

hundred-some years.

And we're not gonna also face the ultimate question, which is, when did disposal come into being? Where is, which is disposal and what isn't disposal? When is it storage and when is it disposal? And those issues are gonna keep coming unless someone defines what's going in and makes, you know, a rulemaking that takes all of these into account as options of long-term storage -- looks like it makes sense. It is long-term storage for decay. That's what we're all talking about. And I offer that as a suggestion.

The spent fuel -- I would agree with Bill from Connecticut. I mean, it's sort of silly to talk about 300, safe-, 300 safe-storage of spent fuel in dry casks and leaving them on-site in an, in wherever -- there's 170 different sites in the United States -- and then worrying about entombment.

I also would raise the question -- and I've talked to Amy about this and she's a little new to this discussion -- having covered this for 18 years, the solution that was promoted by the interest groups for the last decade has been onsite storage of low-level waste until the plants were decommissioned. They looked at the framework for SAFSTOR. So I asked Public Citizen, I asked NEARS, I asked NRDC: now that you have what you want, what were your designs ten years ago and why were you promoting it, and what was the idea back then that's so different than it's being promoted now?

BALDWIN: I think -- Dave Baldwin with

Radiological Services. We're working with Stone & Webster and Maine Yankee on the Maine Yankee decommissioning project. And we've been responsible for the technical development for the rubblization approach, and I'd just like to make a clarification for the record and perhaps for the folks in the room.

What we're doing in terms of rubblization is completely distinct from entombment. It's not low-level waste disposal. It's compliance with 10 C.F.R. 20 subpart (E), 25 millirem. Extensive decontamination is going on before the concrete is rubblized and there is no accounting whatsoever for the existing structure in the calculations and in the dose assessments. I think that distinction needs to be clear in everyone's mind. Thank you.

FELDMAN: Thank you.

LITTLETON: Brian Littleton with the EPA Office of Radiation and Indoor Air. I think that -- I wanted to bring out a couple of points. The first is that entombment poses some very similar concerns, I guess, as rubblization did. And the EPA, I guess, summarized the policy concerns about this in a letter that we sent off to the NRC. Some of those concerns basically are, I guess, handling of hazardous waste, um, and whether they're going to be establishing *de facto* low-level waste sites throughout the nation.

I guess the other thing is -- well, I wanted to bring that point up and I guess go on the record as saying that.

FELDMAN: Thank you. I'd like to go on to the next issue, and that is what financial provisions would be

required to pay for the future expenses that could be expected during the time when restrictions for the entombment must be maintained? Anybody on the panel want to look at that? Paul?

GENOA: Yeah, Paul Genoa, NEI. And I would assume that the same financial obligations as are currently held by licensees to decommission their facilities would stay in place. They would change in form because of time period. They perhaps would change in the amount of money necessary and the rate at which it's collected. But clearly, the industry would anticipate that it would continue to have financial responsibility and that there would be suitable financial instruments and obligations imposed on it, either by the NRC or a post-license termination by what other agency or institutional controls would impose that. I mean, transfer to the state -- I mean, you could envision different situations.

But I think it's important to remember that nuclear utilities are one of the few industries out there that have prepaid for all this problem to be solved. I mean, the high-level waste fund has been funded; the decommissioning funds are in place. They have acted responsibly to take care of, of the waste products of their operation, and those waste products are unique. They're hazardous, yes, but they can be managed and they are small in volume, highly concentrated, easy to isolate, and relatively easy to control. And they've been prepaid for their disposal. And I would expect that in some change in entombment, that that would be a key component of it to

ensure that the public has confidence that the financial assurances will be in place to make sure that that's taken care of.

FELDMAN: Thank you. Amy? Just a second.

SHERMAN: Concerning the financial provisions and staying on the theme that I'm speaking on, as you know, the Federal government is in breach of contract for not taking spent fuel and therefore it's our expectation that the Federal Government will be responsible for both security and, and monitoring costs for the spent fuel that gets left. And should our worst fears occur, which is that they don't take the fuel from the site, we would expect the Federal government to be responsible for the financial provisions.

And what we need from you, Carl, is an understanding of what additional monitoring beyond what the Federal Government would already be required to provide for the spent fuel is necessary for the decommissioning -- necessary for the reactor and the rest. And, granted that a little bit of my talk or my comments are tongue-in-cheek because I want to make a point -- that's something that is needed.

Now, the other arm of this comment is that, as I mentioned, most of the nuclear plants have a couple hundred million put out already. And if you just account for the difference between the growth of costs, and if it was entombment, the costs as we've seen already from the PNNL study are less, and the growth of the fund over time -- somebody gets a huge amount of money here. Rate-payer money that's funded the generosity of the nuclear industry. And

so the way the money works out, it's not a problem because the amounts are so huge. The amounts that are made through the investment of the hundred and two hundred million dollar funds are so huge that paying the cost for the entombment is not a problem.

FELDMAN: Okay. Jack, you want to say anything?

SPEAKER [P]: No, that's okay.

SHOLLENBERGER: I'd like to --

FELDMAN: Amy.

SHOLLENBERGER: Well, first of all I'd just like to -- I was gonna say the same thing, that the money that the nuclear industry has so valiantly put aside for decommissioning is actually rate-payer money, and so I think that any financial provision should include that any savings that are, that happen because of entombment supposedly costing so much less than any other low-level waste option, should be set aside in escrow, either for future mitigation, if that's necessary, or for public use, if mitigation is not necessary. If what they're saying is true and it's totally safe and nothing ever happens, the money should definitely not go back to the nuclear industry because it's not theirs to begin with. It's rate-payer money and it should either go to the state or to the public for use. Rate-payers -- that's the public.

[Laughter.]

GENOA: Yeah, Paul Genoa, NEI. And, you know, clearly the monies being put away that were required to be put away are rate-payer monies. But the way that that is collected has a direct effect on our competitiveness. And

it has a direct effect on what we've been able to do. And although deregulation goes on across the country -- and I agree with you, if the utilities were not expected to bear any extra burden in the case that things go sour, then they should not be allowed to gain any reward or benefit either. But unfortunately that's not the way it often goes.

Rather, you're told that if you do a good job you can't be rewarded, but if you screw up we're gonna make you pay for it. And so I think you need to balance the approach. And I agree with you a hundred percent -- the funds were put there to a purpose and that's what they're there for. But, you know, I guess that goes on to say that if you get the job done for less money, the funds should go back to the public, but if it actually costs you more, then you shouldn't be stuck with the bill. You should be able to pull that from the public as well. I mean, it can't go both ways. It has to be equitable.

GUNTER: Paul Gunter, Nuclear Information Resource Service. The question though is, to what standard will ultimately be accepted and acceptable? And clearly, we concur that the monies should be set aside to meet any subsequent eventualities that the current standard is found to be inadequate. And clearly, the debate is already on between EPA and NRC. And in the light of that uncertainty, it makes perfect sense for this money to be escrowed for either public use or for protection of public and environment.

SHERMAN: May I comment again? Bill Sherman, State of Vermont. Commenting to Mr. Gunter and to Ms.

Shollenberger. In reality, a lot of these decisions are already being made in the deregulation and restructuring arenas. In many of those cases, the utility, there is a transfer of the fund and transfer of the risk, and so that's something that's been made. Also, in the sales of nuclear plants that are occurring, those decisions are being made. Just as Mr. Genoa mentions, there's an assuming of the risk and the possibility of benefit, but oftentimes it's a done deal.

FELDMAN: Would you like to say something, Paul? Any other comments?

[No Response.]

FELDMAN: Okay, we're gonna move onto issue number 8. This was brought up earlier. The issue is, is there any indication of the number of licensees intending to use the entombment option.

GREEVES: I think I have a shot at this one. Paul Genoa, NEI. Yeah, first of all, let me say that, you know, as soon as we heard about your report, and actually well before the report was even instituted, we've been interested in the issue. We've been following it. We've always thought of it as an option. We certainly would not look favorably on it as a requirement, but we believe that from, proper contingency planning on a regulatory basis should be in place in case it's necessary. And to that end, of course, there are many people interested in how it would pan out. And so a recognition of interests is just that: a recognition of interests. But with us here today we have member that represent about 33 reactors, which is about a

third of the fleet. And I'll just run through them to give you a sense, and if any of you care to stand up, that'll be fine.

We do have Southern Nuclear represented.

We have Entergy plants represented.

We have GPU Nuclear represented.

We do have South Carolina Electric and Gas, D.C. Summer Station represented.

We have Florida Power and Light represented.

We have Amergen Union Electric represented.

We have Florida Power Corporation represented, with John Paul Cowan, Chief Nuclear Officer.

We have Maine Yankee represented.

We have PECO Amergen -- excuse me. PECO Amergen represented.

And of course, I'd like to count BNFL, but we really can't -- you guys have a different approach.

But fundamentally, just within this room is an expression of interest that they came here today to give you their comments and they represent about a third of the fleet. And I know that there is interest among members who weren't able to come here today.

FELDMAN: Thank you. Any other comments on this issue?

SHERMAN: Oddly enough, I'd like to comment on this one as well.

You know, the way that this works out is very interesting, and we'll comment on what a state might feel about this too. For states in which rate-payers are

responsible for decommissioning costs and for which for which rate-payers may be able to get back any overage of the fund, states could very well be interested in this because the money involved is huge.

So, to one extent, it's possible to see states that will be interested in this, although that's balanced by the desire to remove the radioactivity. And so it all depends on costs versus a balancing of the radioactivity and of course what happens to spent fuel.

But the next part of that is that, if the state is, and the utilities are restructured, you have a complete shifting of the interests. And the shifting of the interests goes like this: the state no longer has a stake in it usually, because usually the deal on the decommissioning fund has been made; stranded costs are being or have been paid off. And therefore, what you have is you have a situation where rate-payers will not benefit either way. They've been levelized out. So you have a shifting of interests where it is then in the interest of the utilities to do entombment because they could end up pocketing a bundle.

It's in the interest of the states to require immediate dismantling. That's what they paid the money for; that's what they'll want; that's the safest solution. So I think that one thing you can do in terms of looking at the future interests of, of Mr. Genoa's clients is watch the restructuring and see where the interests lie.

FELDMAN: Thank you. Any other comments on this issue?

GOULD: Yeah, my name is Al Gould with Florida Power and Light Company, and we have read the report that was developed by PNNL. We're encouraged by the conclusion of PNNL and the NRC that this can be a safe and viable decommissioning technology, and we would urge the Commission to go forward with the guidance and rulemaking necessary to make this an option for future decommissioning.

As far as our state goes, I think you've already heard from the State of Florida. You've had appropriate regulators from the State of Florida already comment in correspondence. Thank you.

FELDMAN: Thank you.

SAWYER: Paul Sawyer, PECO Energy. First I want to say that I think this is a good forum and I think that we're learning a lot about the options of entombment. But I think that, again, it's gonna be very site-specific. It's, you know, like Florida Power there's gonna some sites out there that's gonna make it very site-specific. But also, the single sites -- and I'll use Vermont as an example. Being a good nuclear neighbor, and if the deal's already cut, you know, for fulfilling that obligation, the state wants to see it gone. And they want the fuel gone, too, of course. But they want to see that, the power plant return to green.

Big Rock Point -- most of you know Big Rock Point. I mean, if you go look at what they're gonna do, in the end that's gonna be a real positive thing as far as returning it back to green in a reasonable amount of time. But then you'll take a site -- and I'll use a PECO site, Peach

Bottom. It's got a unit 1 that's been shut down since the '70s. Hopefully, or maybe one day Peach Bottom 2 or 3 will extend its license and have an opportunity to run much longer.

So then you start pushing Unit 1's 60-year limit. And it's a high-temperature gas-cooled reactor. The opportunity for it to be entombed and maybe never decommissioned is, you know, is possible. Because then once the Peach Bottom 2 and 3 shut down, you might still have a 60-year or 80-year or 90-year option, so you're really falling way behind on the Unit 1. So there's, I think it's very site-specific and it isn't a global thing. And I don't think you'll see it, you know, across the U.S.

STEVENS: Yes. Mike Stevens with the State of Florida. As FP&L mentioned, you know, we have sent some letters and some correspondence in addressing the issue. Basically what that entails is, you know, the state feels that as long as the public health and safety issues are adequately addressed, that the entombment option should be considered as an option.

FELDMAN: Okay. I guess we have to make a decision, whether we want to go on with another -- it's still early. I guess we should. So -- okay. That sounds great. How about a 15-minute break.

[Discussion off the record.]

FELDMAN: I propose we just go through two issues and -- they're the issues that we were going to discuss tomorrow, but I think we'll be able to finish them today. And if we do, then we probably won't have an afternoon

session.

Tomorrow's session would be in the morning and start at nine, and there would be a number of technical presentations. And then it would be greater-than-Class-C issues, which I would be issues five and six. So today, we would just finish with issues four and seven. I guess we'll give you this one to start.

The issues that I was gonna discuss tomorrow, which we'll continue with today were the other issues, namely the ones that were not directly technical or regulatory. And issue four, which was answered somewhat in part before, is how significant would the entombment option be on the state's resources if it were implemented. Would you like to have a crack at that, Bill?

SHERMAN: I guess. Dr. Wilds, I don't know if you would like to speak about this. I saw you kind of edging, and I -- if you would, I would appreciate it if you could say something.

WILDS: Ed Wilds, Connecticut. How significant it would have on the state's resources? I guess the question is, when would the license be terminated? You know, that would be the first question. Is it gonna remain a licensed facility? Under what Part will it be licensed? Are you gonna transfer the regulatory authority if it goes from a Part 50 license to a Part 30 for the agreement states? How's that transfer gonna go across? You know, are you gonna give the states that are agreement states -- if it is gonna go from Part 50 to Part 30 -- the authority to decide whether entombment would be allowed or not? You know,

there's a lot of questions here that I didn't see answered in the paper.

FELDMAN: I'd just like to give a clarification of when we talk about termination of license. The way we do any of this now with the Part 20, if entombment were a generic option and the licensee came in and said he wanted to terminate his license -- let's say after ten years he was gonna entomb it -- the license would be terminated and the NRC would no longer regulate it.

WILD: That's after ten year, right?

FELDMAN: Yeah. It could be even after ten years. However, it could also be that he wanted to keep it in a safe storage say for 50 years or 100 years and then entomb it. Until he went to a license termination state, the NRC would be involved, presumably. That's, at least how it's being done now.

WILD: Right, okay. Then the question is, for the non-agreement states what would happen? You would have a facility that's entombed, that would be pretty much like a low-level waste disposal facility with engineering barriers. In a non-agreement state, that license is terminated and now you have an unlicensed facility. I mean, I see all kinds of problems in either way that you go when you start discussing entombment and its impact on the states.

FELDMAN: Okay. Any other -- Paul?

GENOA: Paul Genoa, NEI. And I think -- you know, clearly this is a new concept so we can't always look to experience, but there is some experience that was identified in your report, so there's some -- you know, we

can get some idea. And the PNNL report, Appendix A, prepared for this entombment evaluation, shows the Nebraska experience with the entombed Hallam nuclear power facility.

The Nebraska Department of Health has been performing analytical monitoring for groundwater samples and for dose rate surveys. And this has been a cooperative relationship. And that perhaps could be further explored to see what the real cost implication is there.

The experience in the Pique, Ohio facility has been that no significant changes have been detected in that facility and no releases to the environment have been recorded. And as we heard earlier from my colleague from SCANA, their joint venture decommissioning of the reactor there in South Carolina -- after 30 years, the reactor was opened up and essentially it was as it was the day the closed it. So clearly there are some monitoring costs associated, some observation. Those costs should be borne by the utility responsible. But they seem to be pretty minimal, or they could be.

FELDMAN: Any other comments from the panel? Yes.

SPEAKER [P]: That reminded me of something too. I've been to quite a few of the shut-down reactors, and any experience with those would be helpful insights, from mothballing of those facilities that, that could impact this would be helpful. I know that at various ones, there's been problems with, maybe, the in-leakage, depending on, you know, where the containment is relative to groundwater table and different things like that, failure of a sump, or

something like that. Any kind of insights like that would be helpful.

FELDMAN: Yes.

KLEBE: Mike Klebe, Illinois Department of Nuclear Safety. Maybe I'm a little bit confused here, especially after Dr. Wild. Walk me through the, the license process here, if you could, all right. You have a nuclear reactor that's licensed under Part 50. They decide they want to entomb it and terminate their license. So you've got it licensed under Part 50. When they want to entomb it, then you would license it under Part 20?

FELDMAN: No.

KLEBE: What happens? Walk me through that process.

FELDMAN: It's a Part 50 license. They have to comply with various parts of our code. Part 20 is one part of the code, but it's under license and it's under Part 50. And termination of the license for power reactors -- power reactors are licensed by the NRC, not the agreement states, and if they terminate the license -- as in entombment -- when the license is terminated, and let's presume it's conditional or restricted release, then the NRC is no longer involved in regulating it at that point, or oversight.

But it would be surveillance and maintenance -- just as the current Part 20 subpart (E) has recently been implemented, it would be a similar kind of concept that if you were using a Part 20, that other parties other than the NRC would be involved in the maintenance of the facility. Funds would have been put up by the licensee for that

purpose. And the process is that at the time when they're ready to terminate the license, they have to submit something called a license termination plan under 50.82, and that has to be approved by the NRC and becomes a condition of license for the licensee, for the Part 50.

And then the implementation of that and the agreement by the Commission that they have fulfilled the obligation in doing what they had to do as part of that license termination plan would then mean that the Commission would then terminate the license and whatever maintenance and surveillance, etc., was gonna be done would then be done by groups outside the NRC.

KLEBE: By groups outside the NRC?

FELDMAN: Yeah, it could be a local community. There are, there's a whole process in Part 20, subpart (E), as to how this structure is set up and implemented in regulatory guides and a whole bunch of things.

KLEBE: Okay, so basically -- pardon me, I'm just a bonehead mining engineer. But, so you've got a facility that was licensed under Part 50. It goes through the license termination of 50.82.

FELDMAN: Yes.

KLEBE: The utility comes to some agreement with some third party or parties --

FELDMAN: During the time when the license is still in effect.

KLEBE: Correct. So that at the time of the license being terminated, then future monitoring or future responsibility for that facility no longer rests with either

the NRC or the utility; it rests with those third parties that are involved.

FELDMAN: Correct. And that already exists in the rules, but not for entombment, but for a condition called "license termination with restricted release." And typically something like a site restriction might be placed -- it usually doesn't involve very much in terms of engineered constructs. Entombment would be, could be a little bit more of an aggressive client of engineering analysis.

KLEBE: Okay, so do you have any examples of who these types of third parties are? I mean, you had mentioned local community, but somehow it doesn't seem --

FELDMAN: It could be the states. It could be other parties other than the NRC, or the Federal Government directly.

KLEBE: Then let me ask you the question: if you're considering -- and again, this isn't necessarily the State of Illinois' position -- but if you're considering having the states being long-term responsible for this facility, why would they want to do that? I mean, what is the incentive for the state to take over the long-term monitoring of this entombed facility?

FELDMAN: Well, it's a closure type of thing. It's the same situation that currently exists now. There can be economic reasons. There can be a lot of reasons. I don't know -- that's an open question that some people within the state should answer. Not me. But obviously there are pros and cons for these various things, and there

are advantages and there are disadvantages, depending upon how it's done and what is being done. But it is, that rule is in effect now. It doesn't have to be the state, though. It could be any other amenable group that has to take on responsibility. Yeah, Paul?

GENOA: Paul Genoa, NEI. Could I put out a hypothetical example and see if that makes a --

FELDMAN: Sure.

GENOA: -- point. What if a utility that was, had continued to its property a recreational property that was of some value. Perhaps it was even, it was currently or it was envisioned as part of a conservation group to preserve that area -- that riverfront, that lakefront, that oceanfront, whatever.

I mean, is it possible that an agreement could be arranged where the long-term monitoring funds, the property could be deeded to that group under certain caveats and conditions that they would be responsible for doing x, y and z? In return, perhaps there would be a management fee that they could claim from that funding, plus, you know, residual use of the property for some purpose that was considered of a benefit and so forth. Is that in line with what was envisioned?

FELDMAN: Yes. That would be permitted under Part 20.

KLEBE: Thank you.

FELDMAN: Yes.

WILDS: Ed Wilds, again. I guess the point I wanted to get across was that transfer, when you go from a

Part 50 license and you go through license termination. That can be very troublesome to have a facility that's entombed in a state that would be unlicensed, so to speak, let's say an agreement state. And I think there's gonna have to be more discussion and more development in the area of the transfer of these responsibilities to the states because they're gonna want to have a say in what happens at that facility, you know, after the NRC has walked away because they will want some regulatory oversight, if there is going to be low-level waste entombed there. That's gonna be a fact.

And to say that at some point we will allow the entombment at a reactor facility, and then if they meet license termination, their license will be terminated and the NRC walks away, I think, is a very simplistic view of what's gonna be happening here, and really puts a lot of responsibility onto the states, then, to come back and answer the question, okay, how are we gonna license this facility? What if our, what if agreement state rules do not allow a facility like that to be licensed inside their state? How are you going to address that situation, where they have a facility that is entombed over low-level radioactive waste but their rules and regulations don't allow that. So, you know, that's why I think that there's gonna have to be much more involvement with the states and much more involvements possibly with the states in the development and approval of the license termination plans, if entombment is authorized.

FELDMAN: Yeah, one of the things I mentioned

when I was given the discussion earlier was, one of the things I mentioned earlier when I was giving my presentation was hypothetical way of doing licensing for entombment, because obviously we've never done it. And what made it look attractive to many people was this Part 20, subpart (E) that we now have, because in the past we only had unrestricted release. But now we are allowed restricted release, subject to health and safety and criteria on residual radioactivity that's left behind, but not for an entombed site but for restricted-release type sites.

So there are other ways of doing regulations as well, and I just wanted to point out that what I said before was purely hypothetical.

SHOLLENBERGER: I just have a question. I'm wondering if, once the license is terminated, if understand it correctly, the low-level waste will be dangerous to some degree between 100 and 300 years, depending on what kind of waste, what's included in the low-level waste, possibly a little longer if the greater-than-Class-C is included in the entombment.

And if I understand what's in the paper correctly, the license could terminate at some point from 60 to 135 years or so after the entombment happens. And I'm wondering then, after the license is terminated, we're talking about who's responsible for monitoring the site, but I'm wondering who's responsible if some type of release above whatever standard is set happens? Who would be responsible for cleaning it up? And in the example that Paul gave, would the conservation organization be responsible for cleaning up

the site if, for some reason, the engineered barriers did fail? Is that going to be addressed at some point?

FELDMAN: I hope so. We're not planning on a specific address of that, but that's an open question. I think if it was a real health and safety situation, the government might step in, but that's --

SHOLLENBERGER: Well, I think it's important to address it because the NRC seems to take a stand that if the reactor, the plant, when they, when they apply for license termination, they have to give reasonable assurance that that won't happen, that there won't be any kind of problem, but they don't, they don't have to do anything if it does happen, I guess. I think in the other scenarios, it's a different scenario because the waste is removed; it's not onsite anymore. So it becomes the responsibility of whoever gets it, where it's removed to. And I'm thinking that it might need to be addressed in any kind of a proposed rule that you would set forth.

GUNTER: Paul Gunter, Nuclear Information Resource Service. As long as we are addressing hypothetical issues, if in fact we follow through on this hypothetical situation, I would like an answer. If in fact that licensee is no longer responsible, if in fact the NRC is no longer responsible, under such a hypothetical situation, who is liable? What about the whole question of liability?

FELDMAN: It's an open question. You know, there have been situations in the past where there were problems at sites that were licensed, and the government has stepped in and take care of them. And sometimes they've tried to

get the people who've had the site to take care of it and vice versa, even though the license was terminated. So it's just an open question.

GUNTER: Well, that's the NRC's position, but I'd like to hear from the generators.

GENOA: Well, currently Superfund would cover that, if I understand it right. But the, the hypothetical situation I put forward envisioned that a. financial securities were transferred along with that long-term responsibility. And if the NRC has done their job, then the amount of monies put forward would be sufficient to cover such contingencies. And the NRC's already done the assessment to see that the release of the material, or the facility, under those constraints is adequately protective of public health and safety.

But I guess I wanted to get back to an earlier point, hypothetically, was that what we've talked about -- and actually if I understand it right, under the restricted release, your license would be terminated quite quickly after it was entombed, perhaps not, after 100 years. But I would put forth that perhaps that is an alternative, that there would be, perhaps it would be some streamlined licensing control so that you, the NRC, had direct control over the licensee and that financial assurance for some considerably longer period of time. I mean, that would be another option and that avoids, you know, state concerns and so forth, perhaps.

KLEBE: Mike Klebe, State of Illinois. Question for the NRC. In the environmental impact statement put out

for Part 61, only, you only assume that state government would be around, or could be relied upon for 100 years to provide institutional control. Now if you have some third party other than a state government, how long do you envision that they can be relied upon for, to still be around, if it's a municipal government or if it's a conservation association? I mean, how, what sort of credence in some life expectancy of those organizations is the NRC willing to put?

FELDMAN: That's -- again, that's something I can't answer directly. I think part of the answer is that when license is terminated, it's expected to be a rather trivial situation that exists and there are relatively minimal types of things that have to be done. If that's not the case, then the license, as I recently said, then the license wasn't handled properly and the termination wasn't done correctly. So that's, that's sort of an answer. That's as far as I can --

SPEAKER [P]: Carl, I had a question for the folks from PNNL in their report. When you looked at the three reactors that DOE entombed, if you know, did they, did they own those sites or did they turn over ownership to the state, or how did that work?

SHORT: Yes. DOE owns those sites. They lease the facilities to the entities that are using them.

SPEAKER [P]: And do you know what, for instance, in the state of Nebraska where they do the monitoring -- I mean, what is the incentive for Nebraska to do that, other than --

SHORT: Actually, in that particular case the site is still being used by the power, by -- I can't remember the utility, the name of the utility. But the utility's still using it.

GENOA: NPPD?

SHORT: Pardon?

GENOA: NPPD?

SHORT: Nebraska -- yeah. Nebraska Public Power. The state is providing long-term monitoring under DOE, so DOE's paying for it, and the state has an interest in continuing to follow what's going on with the site. In the case of Piqua, contractor's usually hired to do that, and then the report is given to the state of Ohio and of course to DOE. But Ohio doesn't receive any funding. They just follow the results of the survey.

FELDMAN: Any other comments?

GENOA: The Envirocare facility in Utah, that has a different relationship with the state, doesn't it, for long-term responsibility? Jim, can you comment to that?

KENNEDY: The Envirocare facility -- Jim Kennedy, NRC staff. The Envirocare facility will not be turned over to that state when it's closed down. It's private ownership and it will be private ownership indefinitely. That was an exemption to the regulations that was granted by the State of Utah.

FELDMAN: I'm just going to go into issue seven because it's so similar to issue four, and see if anyone has any additional comments. What is the opinion of the states on the entombment option? Is the possibility of ultimate or

long-term management by the state a concern? And obviously, a number of opinions were already expressed in that area. Any additional comments?

SHERMAN: Yes, I'd like to speak, if I might.

FELDMAN: Sure.

SHERMAN: Vermont doesn't have any official policy in terms of whether we want entombment, but we can definitely say we have an interest in that being an option. So as a first step for Mr. Greeves' comments, there's at least one state that has interest. I think in general, but certainly for Vermont, the first preference for states is immediate dismantling to assure the best protection and removal of radioactivity.

But as I've stated here, there are a couple reasons that either deferred dismantling -- even deferred beyond the 60 years -- or entombment are attractive. If the rate-payers may still benefit, and especially if there is no low-level storage area available, it's attractive. And economically very attractively, potentially. And then, as I have mentioned, there is a tremendous attractiveness if the rate-payers can benefit for deferring the decommissioning, as long as spent nuclear fuel is onsite.

FELDMAN: Any other comments? Yes.

GERWITZ: I'm with New York State, New York State Energy Research Development Authority, and we actually own the Wasa Valley demonstration, or the site where the Wasa Valley demonstration project is located. And that's a DOE-operated site.

In your paper, there was some brief discussion at

the beginning of the SECY about applying this concept or potentially applying it to facilities beyond reactors, such as closed high-level waste tanks or other types of facilities, and that's where our interest comes in. There's obviously some potential applicability to our site, and understanding that some of the details here about future liabilities associated with the site and those entombed facilities are of key interest at this facility as well. And I guess I'll say, just from a general standpoint, I don't know how many other locations there are across the nation that may have, where these concepts could be applied to non-reactor type facilities, but I guess I just want to note that, or go on the record of noting that that may be something the NRC will definitely want to consider as they amend Part 20 if you choose to.

FELDMAN: Thank you. Any other comments?

HELMINSKI: With regard to states, you gonna deal with the compacts -- is that valid to talk about now?

FELDMAN: Sure.

HELMINSKI: I was struck by John Greeves' comment at the beginning of this workshop when he said, we want to know from you all whether we should even be considering this. How many are interested? He asked another question: should NRC even be talking about this issue, if indeed the states, through the compacting legislation, have control over these disposal sites? Unanswered question. It was brought up earlier.

I personally think that they don't and I've argued that for a number of years, and Envirocare facility in Utah

is a perfect example of a site that's been recognizing and honoring a compact, but in, they really believe that the compact has no control over them at all. They have been good neighbors and they have said it that way. So I think it's to NRC's, in answer to John Greeves' question, should you be doing this at all, I think your first order of business is to write a paper from your General Counsel's office to go through the language of the compacts, all the language, and to see if the states, through the compacts, have any authority at all over entombment as a disposal D&D strategy. That would be helpful to everyone. And so I say that that's a necessity, to answer John Greeves' question.

FELDMAN: Thank you.

HELMINSKI: And pay attention to the last phrase of every low-level waste compact when you do that. It says, this act does not construe any authority on the states or compact not granted under the Low-Level Waste Policy Act of 1980.

FELDMAN: Yes, sir.

WILDS: Well, Connecticut feels it has the authority over the low-level waste sites. I want to get that on the record. We have, we actually have passed a state statute that there will be no low-level waste sites sited in the state of Connecticut without the express legislative approval by our government. So, you know, that's where we start seeing the problems because our facilities in the state would be government-owned and operated. And now the NRC is sort of putting into the game a privately owned facility without a lot of input from the

states.

FELDMAN: Thank you. Any other comments?

[No Response.]

FELDMAN: I just was supposed to make a note of the fact that earlier, there was a mention of an EPA letter to Mr. Greeves on why EPA on preliminary concerns on rubblization concepts, and John said to make sure I tell people that he did get it today. It came in today's mail, so he does have it.

With that in mind, then I guess this session is over unless has any other general comments they wish to make. Oh, sorry.

SHOLLENBERGER: I have one -- it's actually a question. And I apologize for not being here this morning for the presentations. I was in another NRC meeting because they're scheduled at the same time. But, I was looking over -- let me get the name here -- Mr. Short and Mr. Smith's "entombment option viability" presentation. I don't know if they're still here.

FELDMAN: Yes, they are.

SHOLLENBERGER: Great. One of your viewgraphs under "summary of conclusions" states that "entombment of reactors is a viable decommissioning option." And then the second bullet under that is, "at cost, low-level waste volume and occupational exposures are significantly reduced as compared to decon, and slightly reduced as compared to SAFSTOR."

And I just had a clarifying question on that because I have a report done by the Office of Technology

Assessment in 1993, called "Aging Nuclear Power Plants -- Managing Plant Life and Decommissioning." And Chapter 4 of that report deals with decommissioning. And there are two charts in that chapter that show the, mostly the occupational dose, comparing the occupational dose of decon, SAFSTOR and entomb. And those charts claim that, first of all, occupational dose is only slightly reduced from decon, and it's almost three times as much as SAFSTOR. And so I'm just wondering where you got the information for your viewgraph.

SHORT: I haven't seen that report you're looking at, but I don't -- from what you're saying, it doesn't sound like it's too inconsistent with our study. If you look at the later viewgraph towards the, almost the very last, depending on whether you do immediate decon, I mean immediate entombment or delayed entombment, your worker dose may only be slightly reduced to significantly reduced. Under a delayed entombment situation, that's where you receive your dose savings; if you do an immediate entombment, you won't save hardly any, okay, in terms of dose.

Back to the cost issue, I'm not -- the only answer I can give to that is, I don't know -- as long as your surveillance and monitoring costs, annual surveillance and monitoring costs are not overly burdensome, I would still challenge any analysis that says that those costs would be higher than immediate decon.

SHOLLENBERGER: I wasn't speaking to the cost at all. I was specifically interested in the dose, because,

you know, this, this chart doesn't talk about delayed or immediate. It talks about internals in and internals out. And I'm assuming it's all immediate, is my assumption, but I'm not sure.

SHORT: Okay, an immediate case, where you're removing those internals immediately, there's very little dose savings.

GENOA: Paul Genoa, NEI. I would guess that at the time this report was generated back in '93, entombment was defined as a 60-year period. And so it would be out of sync with your current report, which is looking at entombment into the future, so that may skew the results.

FELDMAN: Any other general comments or comments at all?

[No Response.]

FELDMAN: Okay, I guess with that, we're gonna start tomorrow at nine o'clock with several technical presentations. And then we'll have another panel on greater-than-Class-C issue and whether or not we can leave something that's greater than Class C in an entombment configuration. And the session in the afternoon is no longer necessary because we've covered those issues. So we'll adjourn sometime early afternoon.

I want to thank the panel for coming and doing a great job, and thank the audience.

[Whereupon, the meeting was recessed, to reconvene at 9:00 a.m., on Wednesday, December 15, 1999.]